CORONAVIRUS DISEASE (COVID-19): PSYCHOEDUCATIONAL VARIABLES INVOLVED IN THE HEALTH EMERGENCY

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CORONAVIRUS DISEASE (COVID-19): PSYCHOEDUCATIONAL VARIABLES INVOLVED IN THE HEALTH EMERGENCY

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Table of Contents

06 ***Editorial: Coronavirus Disease (COVID-19): Psychoeducational Variables Involved in the Health Emergency***
Jesus de la Fuente, Douglas F. Kauffman, Michel S. Dempsy and Yashu Kauffman

08 ***COVID-19 in Guangdong: Immediate Perceptions and Psychological Impact on 304,167 College Students***
Xueguo Li, Sihui Lv, Lili Liu, Rongning Chen, Jianbin Chen, Shunwei Liang, Siyao Tang and Jingbo Zhao

21 ***Alone With the Kids: Tele-Medicine for Children With Special Healthcare Needs During COVID-19 Emergency***
Livio Provenzi, Serena Grumi and Renato Borgatti on behalf of Mondino EnFORCE (Engaging with Families through Online Rehabilitation for Children during the Emergency) Group

27 ***Influence of COVID-19 on the Perception of Academic Self-Efficacy, State Anxiety, and Trait Anxiety in College Students***
Inmaculada Alemany-Arrebola, Gloria Rojas-Ruiz, Juan Granda-Vera and Ángel Custodio Mingorance-Estrada

34 ***Systematic Review of the Literature About the Effects of the COVID-19 Pandemic on the Lives of School Children***
Javier Cachón-Zagalaz, María Sánchez-Zafra, Déborah Sanabrias-Moreno, Gabriel González-Valero, Amador J. Lara-Sánchez and María Luisa Zagalaz-Sánchez

42 ***Emotions and Reactions to the Confinement by COVID-19 of Children and Adolescents With High Abilities and Community Samples: A Mixed Methods Research Study***
María de los Dolores Valadez, Gabriela López-Aymes, Norma Alicia Ruvalcaba, Francisco Flores, Grecia Ortíz, Celia Rodríguez and África Borges

56 ***Parents' Perceptions of Student Academic Motivation During the COVID-19 Lockdown: A Cross-Country Comparison***
Sonia Zaccoletti, Ana Camacho, Nadine Correia, Cecília Aguiar, Lucia Mason, Rui A. Alves and João R. Daniel

69 ***The Psychological State of Teachers During the COVID-19 Crisis: The Challenge of Returning to Face-to-Face Teaching***
Naiara Ozamiz-Etxebarria, Naiara Berasategi Santxo, Nahia Idoiaga Mondragon and María Dosil Santamaría

79 ***State-Anxiety and Academic Burnout Regarding University Access Selective Examinations in Spain During and After the COVID-19 Lockdown***
Antonio Fernández-Castillo

88 ***Consequences of COVID-19 Confinement on Anxiety, Sleep and Executive Functions of Children and Adolescents in Spain***
Rocío Lavigne-Cerván, Borja Costa-López, Rocío Juárez-Ruiz de Mier, Marta Real-Fernández, Marta Sánchez-Muñoz de León and Ignasi Navarro-Soria

99 ***Analysis and Psychoeducational Implications of the Behavior Factor During the COVID-19 Emergency***
Jesús de la Fuente, Douglass F. Kauffman, Michael S. Dempsy and Yashu Kauffman

113 ***High Trait Self-Control and Low Boredom Proneness Help COVID-19 Homeschoolers***
Corinna S. Martarelli, Simona G. Pacozzi, Maik Bieleke and Wanja Wolff

122 ***COVID-19: Are School Counseling Services Ready? Students' Psychological Symptoms, School Counselors' Views, and Solutions***
Mehmet Akif Karaman, Hasan Eşici, İsmail Hakkı Tomar and Ramin Aliyev

136 ***How E-Learning Environmental Stimuli Influence Determinates of Learning Engagement in the Context of COVID-19? SOR Model Perspective***
Junhui Yang, Michael Yao-Ping Peng, ShwuHuey Wong and WeiLoong Chong

148 ***Teachers' Perception of Student Coping With Emergency Remote Instruction During the COVID-19 Pandemic: The Relative Impact of Educator Demographics and Professional Adaptation and Adjustment***
Magdalena Jelińska and Michał B. Paradowski

163 ***Stress, Coping, and Resilience Before and After COVID-19: A Predictive Model Based on Artificial Intelligence in the University Environment***
Francisco Manuel Morales-Rodríguez, Juan Pedro Martínez-Ramón, Inmaculada Méndez and Cecilia Ruiz-Esteban

178 ***No Children Should Be Left Behind During COVID-19 Pandemic: Description, Potential Reach, and Participants' Perspectives of a Project Through Radio and Letters to Promote Self-Regulatory Competences in Elementary School***
Jennifer Cunha, Cátia Silva, Ana Guimarães, Patrícia Sousa, Clara Vieira, Dulce Lopes and Pedro Rosário

197 ***Gamification as Online Teaching Strategy During COVID-19: A Mini-Review***
Francisco Antonio Nieto-Escamez and María Dolores Roldán-Tapia

206 ***Psychoeducational Challenges in Spanish Children With Dyslexia and Their Parents' Stress During the COVID-19 Pandemic***
Manuel Soriano-Ferrer, Manuel Ramón Morte-Soriano, John Begeny and Elisa Piedra-Martínez

221 ***How Has the COVID-19 Crisis Affected the Academic Stress of University Students? The Role of Teachers and Students***
Jesús de la Fuente, Mónica Pachón-Basallo, Flavia H. Santos, Francisco J. Peralta-Sánchez, María Carmen González-Torres, Raquel Artuch-Garde, Paola V. Paoloni and Martha L. Gaetha

237 ***What Type of Social Support Is Important for Student Resilience During COVID-19? A Latent Profile Analysis***
Yingping Mai, Yenchun Jim Wu and Yanni Huang

248 ***Effective Learning Support Towards Sustainable Student Learning and Well-Being Influenced by Global Pandemic of COVID-19: A Comparison Between Mainland China and Taiwanese Students***
Ping Xu, Michael Yao-Ping Peng and Muhammad Khalid Anser

261 *An Innovative Approach for Online Neuroanatomy and Neurorrehabilitation Teaching Based on 3D Virtual Anatomical Models Using Leap Motion Controller During COVID-19 Pandemic*
Esteban Obrero-Gaitán, Francisco A. Nieto-Escamez, Noelia Zagalaz-Anula and Irene Cortés-Pérez

273 *Analysis of Psychosocial Adjustment in the Family During Confinement: Problems and Habits of Children and Youth and Parental Stress and Resilience*
Magdalena P. Andrés-Romero, Juan M. Flujas-Contreras, Mercedes Fernández-Torres, Inmaculada Gómez-Becerra and Pilar Sánchez-López

291 *Experiences With Online Teaching and Psychological Adjustment of High-School Students at the Onset of the COVID-19 Pandemic in Croatia*
Vesna Buško and Petar Bezinović

300 *A Short, Multimodal Activity Break Incorporated Into the Learning Context During the Covid-19 Pandemic: Effects of Physical Activity and Positive Expressive Writing on University Students' Mental Health—Results and Recommendations From a Pilot Study*
Verena Marschin and Cornelia Herbert

316 *A Path Analysis Model of Protection and Risk Factors for University Academic Stress: Analysis and Psychoeducational Implications for the COVID-19 Emergency*
Jesús de la Fuente

340 *Well-Being of Adolescents in De-Escalation Situation: Physical, Emotional, Social, and Academic Impact*
Naiara Berasategi Santxo, Nahia Idoiaga Mondragon, Naiara Ozamiz-Etxebarria and Maria Dosil-Santamaria

350 *Depression and Anxiety in Times of COVID-19: How Coping Strategies and Loneliness Relate to Mental Health Outcomes and Academic Performance*
Sebastian Freyhofer, Niklas Ziegler, Elisabeth M. de Jong and Michaéla C. Schippers

365 *Rethinking the Multidimensionality of Growth Mindset Amid the COVID-19 Pandemic: A Systematic Review and Framework Proposal*
Yun-Ruei Ku and Catanya Stager

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Editorial: Coronavirus disease (COVID-19): Psychoeducational variables involved in the health emergency

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KEYWORDS

coronavirus disease (COVID-19), psychoeducational variables, health emergency, emotional psychological impact, psychological support

Editorial on the Research Topic
Coronavirus disease (COVID-19): Psychoeducational variables involved in the health emergency

This monograph has allowed us to present a psychoeducational view of the effects of the COVID-19 pandemic. We confirm here that research in education contributes its own evidence and specific models for identifying this problem.

The first paper gives us a general overview and review of the problem (Cachón-Zagalaz et al.). Next, a joint editorial paper presents a novel theoretical model that provides for a purely psychoeducational analysis of the pandemic (de la Fuente, Kauffman, et al.).

A second group of articles presents the psychological and emotional impact of the COVID-19 pandemic in students of different ages. Several papers address university students (Fernández-Castillo). Next, other research studies address the preuniversity level, in childhood and adolescence (Andrés-Romero et al.; Berasategi et al.; Martarelli et al.; Valadez et al.; Zaccoletti et al.). Finally, two studies show the psychological impact on students with specific educational needs (Lavigne-Cerván et al.; Soriano-Ferrer et al.).

One especially relevant aspect is the behavioral change in technology use during the pandemic (Nieto-Escamez and Roldán-Tapia; Obrero-Gaitán et al.; Provenzi et al.; Yang et al.). Other changes in the teaching-learning process have also come about during this period (Buško and Bezinović; de la Fuente et al.; Jelińska and Paradowski; Xu et al.; Ozamiz-Etxebarria et al.).

An interesting closing paper offers the perspective of psychoeducational support that has been provided during the pandemic (Karaman et al.).

The Editors of this Research Topic wish to explicitly acknowledge the commitment of the publishers in producing this monograph free of charge. We also acknowledge the authors whose contributions make up the content.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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COVID-19 in Guangdong: Immediate Perceptions and Psychological Impact on 304,167 College Students

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The outbreak of COVID-19 has brought unprecedented psychological pressure to people across China and more widely across the entire globe. The aim of this study was to assess the immediate perceptions of COVID-19 among college students in Guangdong Province, China, and to assess the psychological impact of the outbreak. We conducted a cross-sectional survey of college students via online questionnaires between February 13th and February 22nd, 2020. A total of 304,167 students completed the Impact of Event Scale 6 (IES-6) and other items. The results showed that 155,077 (50.9%) of the students reported stress symptoms, 1,565 (0.5%) reported poor mental health, and 9,752 (3.2%) reported poor sleep quality. Analysis indicated that the students' perceptions of COVID-19 were correlated with psychological stress, self-perceived mental health and sleep quality. Moreover, the analysis revealed that the relationship between types of perception and levels of stress symptoms varied according to the students' demographic characteristics. These findings allow us to better understand psychological stress among students and the factors influencing stress during the COVID-19 outbreak. Understanding these factors will help us to design intervention programs with the aim of alleviating stress among students and reducing the potential for developing psychological disorders.

Keywords: COVID-19, stress, PTSS, college students, China

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INTRODUCTION

A novel coronavirus was detected in Wuhan, Hubei Province, Central China, in December 2019, and on the 30th of January 2020 the World Health Organization declared the outbreak to be a Public Health Emergency of International Concern.[1] The COVID-19 virus has now spread to countries across the globe, the world is facing an unprecedented challenge with communities and economies everywhere affected by the growing pandemic. By 8 March 2020, a total number of 1,352 confirmed cases were confirmed in Guangdong Province, making it the second worst-affected province in China after Hubei.[2] All age groups can catch COVID-19, older people and people with underlying

[1]https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)
[2]https://news.qq.com/zt2020/page/feiyan.htm#/global

medical problems like cardiovascular disease, diabetes and chronic respiratory disease are more likely to develop serious illness. At this time, there are no specific vaccines or treatments for COVID-19. The temporary case fatality rate by WHO is about 2%, but some researchers estimate that the rate is between 0.3% and 0.6% (Nishiura et al., 2020). COVID-19 poses a constant threat to human health with its high level of transmission, severe consequences of infection, and the uncertain duration of the epidemic. Following the outbreak of COVID-19, the Chinese government implemented a series of strong epidemic prevention measures, and all parts of the country had launched a Level I response to public health emergencies by January 29, 2020.

Empirical research has found that public health emergencies and disasters often cause great psychological stimuli to those affected. Studies on health emergencies and catastrophes such as the Wenchuan earthquake, Ebola outbreak and SARS found that such events can cause mental health problems (Chit et al., 2009; Shultz et al., 2015). Once the stimulus exceeds an individual's general psychological response level it can bring serious consequences, including cognitive changes, emotional changes, physical reactions and behavioral changes (Lu et al., 2006; Lee et al., 2007; Huang and Zhao, 2020). However, the characteristics of an epidemic outbreak and a general catastrophic event are very different. The location and scope of a general catastrophic event are determined, and the duration is often transient. However, the occurrence of an epidemic is uncertain in time and space. This uncertainty is more likely to lead to an imbalance in the mindset of the general public, a loss in the sense of security and control, a state of stress, tension, anxiety, confusion, and even hopelessness (Rubin et al., 2010; Wang et al., 2020b). Faced with an emergency, people's initial psychological tension is normal. It enables local authorities to raise awareness of self-prevention, to strengthen prevention capabilities and to implement preventive measures (Leung et al., 2003). However, increasing numbers of confirmed and suspected cases and disease trends in the news can increase people's stress, and some exhibit stress reactions such as fear and nervousness. Due to the prevalence of 'We Media,' the variety of media reports on COVID-19, and restrictions on personal knowledge, individuals may pay excessive attention to the potential risk factors and exaggerate their degree, keeping themselves in a state of continuous stress (Rubin and Wessely, 2020). Long-term excessive stress will cause autonomic and endocrine dysfunction, which will further affect and weaken the immune functions of the human body, leading to a decline in the body's ability to resist disease (Miller and Cohen, 2001). Often this psychological stress response is composed of negative cognitive emotional states (Wang et al., 2020b).

The Chinese government instituted mitigation policies to contain the spread of the epidemic. For example, confirmed cases were quarantined, suspicious cases were monitored and restricted by house arrest, universities remained closed, and people were asked to stay at home as much as possible (Hellewell et al., 2020). These actions are a very effective way to interrupt the transmission of the virus. However, they may lead to more serious mental health problems (Brooks et al., 2020). The prevention and control of the epidemic situation requires people's activities to be restricted or strictly restricted for a long period of time, which affects their normal life, work and study. Moreover, these prevention measures may bring about torment, irritability, or an emotional state of boredom, helplessness or hopelessness. To address such mental health issues in China, the National Health Commission of China has released guidelines for local authorities to promote psychological crisis intervention measures during the COVID-19 outbreak for patients, medical staff, and people under medical observation.[3] However, the outbreak of COVID-19 has also caused mental health problems among the general public in China (Bao et al., 2020). A rapid assessment was conducted via an online survey of 4,872 Chinese citizens, and the findings showed a high prevalence of mental health problems among the general population, especially depression and anxiety (Gao J. et al., 2020). It was also seen that psychological and behavioral responses to COVID-19 had been dramatic during the rising phase of the outbreak (Qiu et al., 2020).

Many studies have highlighted mental health issues in young adults, especially during their years at university (Blanco et al., 2008; Milojevich and Lukowski, 2016; Saleh et al., 2017). At present, there are 33.66 million college students in China, of whom 8.83 million are inter-provincial students. During the outbreak, colleges and universities announced the postponement of school openings, which is helpful for epidemic control (Wang et al., 2020a). Stressors such as fear of infection, prolonged duration, study maladjustment and family financial loss can cause even more mental health problems for college students. College students are a special group of people who accept new things easily, have multiple channels for information acquisition, and have high levels of social media activity. One the one hand, there are some studies showed that up-to-date and accurate health information was associated with lower stress levels (Holmes et al., 2020; Wang et al., 2020b). On the other hand, young people tend to obtain a large amount of information from social media which can easily trigger stress if too much time is spent on information about the corona epidemic (Qiu et al., 2020). Recent research has also found a higher prevalence of depressive symptoms among the young (Huang and Zhao, 2020). Faced with the spread of epidemic information from various sources, college students are more likely to develop disease information deviations, such as catastrophic cognition of the disease, high self-risk perception, an underestimation of their self-coping ability, and cognitive inconsistency, which may contribute to the psychological impact. However, it is unclear how college students perceive this epidemic and how their perception affects their mental health. An assessment of outbreak-associated perceptions of COVID-19 and the psychological impact on students is therefore an urgent need.

The current study conducted a survey of students in 85 colleges in Guangdong Province on February 13–22, 2020, in order to understand the perceptions of COVID-19 among students and to analyze the relations between perceptions and their recent mental health status. We proposed the following hypotheses. Firstly, the more negative the perception, the

[3]http://www.nhc.gov.cn/xcs/zhengcwj/202001/6adc08b966594253b2b791be5c3b9467.shtml

greater the psychological impact of the epidemic. Secondly, when reality or behavior is inconsistent with perception, the psychological impact is large; but when real events are consistent with perception the psychological impact is small. The aim is to explore the current status of college students' perceptions of COVID-19 and the impact of related factors on their mental health, with the goal of providing information for the formulation of group psychological precautions and related work in universities.

MATERIALS AND METHODS

Study Design and Participants

A cross-sectional survey covering students from 85 colleges in Guangdong Province was conducted between February 13th and February 22nd, 2020, 2 weeks after the Ministry of Education issued a notice on January 27th 2020 on the postponement of the spring semester. An online questionnaire consisted of the participant's informed consent, baseline sociodemographic information, perceptions of the threat of COVID-19, psychological protective measures and rating scales, including the Impact of Event Scale 6 (IES-6).

The online questionnaire was distributed to all directors of the mental health centers of 85 colleges via WeChat. The directors in each college were responsible for the distribution and collection of the questionnaires. Only one response per person was permitted. The senior investigators performed quality control by checking the collected questionnaires daily. The study was approved by the institutional ethics board of Southern Medical University.

Measures

Demographic Information

Participants provided demographic information on their age, gender, grade, nationality, family location, history of physical illness, psychiatric history, counseling history, information about their perceived mental health, and whether there had been diagnosed or suspected cases of COVID-19 infection in their friends, relatives and families.

Perceptions

Two items assessed perceived threats of COVID-19. Participants were asked 'Do you think that COVID-19 infection can be prevented?' and 'Do you think that COVID-19 infection can be treated?' Another item asked, 'Since the COVID-19 epidemic, have you taken the precautions you have learned?' to assess whether they had taken action.

Level of Posttraumatic Stress Symptoms IES-6

The Impact of Event Scale 6 is a useful screening instrument for research in epidemiological studies or in clinical practice, simplified by Thoresen on the basis of the Impact of Events Scale Revised (IES-R) and highly correlated to IES-R (Thoresen et al., 2010). IES-6 is a 6-item self-report measure of psychological response to trauma, with each item rated on a scale from 0 to 4. Its three subscales (Intrusion, Avoidance, and Hyperarousal) are closely affiliated with PTSD symptoms. It can be anchored to any specific event, such as the COVID-19 epidemic. The average score S of IES-6 is categorized as follows: $S < 1.09$ = normal; $1.09 \leq S < 1.5$ = showing stress symptoms; $S \geq 1.5$ = may be diagnosed with PTSD (Jalloh et al., 2018). In this study, for the purpose of detecting the presence of posttraumatic stress symptoms (PTSS) rather than diagnostic PTSD, we used an average score of 1.09 or greater as a cutoff for significant stress. The Cronbach's alpha for the IES-6 in the current sample was 0.782, and the composite reliability was 0.801.

Levels of Other Psychological Impact

Three items were used to assess the physical health, mental health, and sleep quality of participants in isolation at home during the outbreak. Participants were asked, 'How is your physical health?', 'How is your mental health?' and 'Overall, how would you rate your sleep quality during the novel coronavirus epidemic?' A five-point scale rated responses from 1 (very good) to 5 (very poor).

Statistical Analysis

Data were analyzed using SPSS Version 22.0. Descriptive statistics were conducted to characterize the sample's demographic profile and level of psychological stress. A reliability test was used to check the internal consistency of IES-6. Normality of quantitative data was checked using the One-Sample Kolmogorov–Smirnov Test. The results showed that the levels of psychological impact were non-normal continuous variables. Differences among groups were tested by the Mann–Whitney U test or the Kruskal–Wallis H test for non-normal continuous variables, and by a chi-square test or Fisher's Exact test for categorical variables whenever appropriate. Univariate test was used to test the interaction between demographic variables and perception types. Values of $p < 0.05$ (two-tailed tests) were considered statistically significant.

RESULTS

Demographic Characteristics of Participants

Overall, 361,969 participants answered the questionnaire. Among these participants, 19,322 were ineligible because of living outside Guangdong Province and 38,480 questionnaires were invalid, leaving 304,167 respondents who completed the questionnaire successfully. The response rate was 84.0% (304,167/361,969). All 304,167 participants were from colleges in Guangdong Province and lived in Guangdong.

Of the 304,167 participants, 59.9% were female and the majority (84.4%) were 19–22 years old. A total of 155,077 respondents (50.9%) were identified as having psychological stress symptoms. However, the majority rated their physical health as "very good" (69.3%) or "good" (25.7%). The majority also rated their sleep quality as "very good" (37.7%) or "good" (37.3%). **Table 1** presents the baseline characteristics for the total sample (n = 30,417) and for the sample divided into four possible perceptions of COVID-19: those students who thought that COVID-19 infection could be prevented and that

TABLE 1 | Demographic variables and perception groups.

Variable (n = 304,167)	All participants (%)	Preventable and curable group (%)	Preventable and incurable group (%)	Unpreventable and curable group (%)	Unpreventable and incurable group (%)	χ^2	df	p
Gender								
Male	122102 (40.1)	116289 (40.1)	2367 (42.7)	2600 (37.3)	846 (56.7)	210.247	3	<0.001
Female	182065 (59.9)	173859 (59.9)	3182 (57.3)	4379 (62.7)	645 (43.3)			
Nationality								
The Han nationality	301657 (99.2)	287773 (99.2)	5500 (99.1)	6910 (99.0)	1474 (98.9)	4.470	1	0.215
Minority nationality	2510 (0.8)	2375 (0.8)	49 (0.9)	69 (1.0)	17 (1.1)			
Age group								
≤18	26918 (8.8)	25742 (8.9)	463 (8.3)	579 (8.3)	134 (9.0)	62.359	9	<0.001
19–22	256817 (84.4)	245087 (84.4)	4624 (83.3)	5877 (84.2)	1229 (82.4)			
23–25	19767 (6.5)	18699 (6.4)	446 (8.0)	506 (7.3)	116 (7.8)			
≥26	665 (0.2)	620 (0.2)	16 (0.3)	17 (0.2)	12 (0.8)			
Grade								
Fresher	121380 (39.9)	116318 (40.1)	2000 (36.0)	2547 (36.5)	515 (34.5)	150.807	9	<0.001
Sophomore	96964 (31.9)	92513 (31.9)	1713 (30.9)	2238 (32.1)	500 (33.5)			
Junior	63265 (20.8)	60027 (20.7)	1327 (23.9)	1566 (22.4)	345 (23.1)			
Senior (4th and 5th)	22558 (7.4)	21290 (7.3)	509 (9.2)	628 (9.0)	131 (8.8)			
Family location								
Rural areas	123351 (40.6)	117868 (40.6)	2227 (40.1)	2703 (38.7)	553 (37.1)	32.340	6	<0.001
County town	92490 (30.4)	88288 (30.4)	1652 (29.8)	2087 (29.9)	463 (31.1)			
City	88326 (29.0)	83992 (28.9)	1670 (301.)	2189 (31.4)	475 (31.9)			
Family member (co-resident)								
1–2 people	12643 (4.2)	11956 (4.1)	277 (5.0)	326 (4.7)	84 (5.6)	41.150	9	<0.001
3people	56534 (18.6)	53920 (18.6)	987 (17.8)	1331 (19.1)	296 (19.9)			
4 people	102447 (33.7)	97896 (33.7)	1764 (31.8)	2324 (33.3)	463 (31.1)			
5 people and above	132543 (43.6)	126376 (43.6)	2521 (45.4)	2998 (43.0)	648 (43.5)			
Daily time spend on reading information about COVID-19								
≤1 h	157258 (51.7)	149228 (51.4)	3127 (56.4)	3993 (57.2)	910 (61.0)	381.506	6	<0.001
1–3 h	115231 (37.9)	110944 (38.2)	1784 (32.1)	2150 (30.8)	353 (23.7)			
≥3 h	31678 (10.4)	29976 (10.3)	638 (11.5)	836 (12.0)	228 (15.3)			
Severe physical illness								
Yes	932 (0.3)	842 (0.3)	25 (0.5)	42 (0.6)	23 (1.5)	100.794	3	<0.001
No	303235 (99.7)	289306 (99.7)	5524 (99.5)	6937 (99.4)	1468 (98.5)			
History of mental illness								
Yes	2187 (0.7)	1989 (0.7)	71 (1.3)	92 (1.3)	35 (2.3)	119.474	3	<0.001
No	301980 (99.3)	288159 (99.3)	5478 (98.7)	6887 (98.7)	1456 (97.7)			
History of counseling								
Yes	11442 (3.8)	10677 (3.7)	315 (5.7)	352 (5.0)	98 (6.6)	125.808	3	<0.001
No	292725 (96.2)	279471 (96.3)	5234 (94.3)	6627 (95.0)	1393 (93.4)			
Infection of friends								
Someone is diagnosed	491 (0.2)	1661 (0.6)	73 (1.3)	81 (1.2)	57 (3.8)	1398.378	6	<0.001
Someone is suspected	1381 (0.5)							
No one is infected	198653 (65.3)	191240 (65.9)	3135 (56.5)	3703 (53.1)	575 (38.6)			
Not sure	103642 (34.1)	97247 (33.5)	2341 (42.2)	3195 (45.8)	859 (57.6)			
Infection of relatives (non co-resident)								
Someone is diagnosed	244 (0.1)	610 (0.2)	28 (0.5)	37 (0.5)	27 (1.8)	2080.461	6	<0.001
Someone is suspected	458 (0.2)							
No one is infected	276063 (90.8)	264649 (91.2)	4704 (84.8)	5721 (82.0)	999 (66.3)			
Not sure	27402 (9.0)	24889 (8.6)	817 (14.7)	1221 (17.5)	475 (31.9)			

(Continued)

TABLE 1 | Continued

Variable (n = 304,167)	All participants (%)	Preventable and curable group (%)	Preventable and incurable group (%)	Unpreventable and curable group (%)	Unpreventable and incurable group (%)	χ^2	df	p
Infection of families (co-resident)								
Someone is diagnosed	83 (0.0)	245 (0.1)	14 (0.3)	15 (0.2)	15 (1.0)	2756.788	6	<0.001
Someone is suspected	206 (0.1)							
No one is infected	294847 (96.9)	282097 (97.2)	5198 (93.7)	6487 (91.5)	1165 (78.1)			
Not sure	9031 (3.0)	7806 (2.7)	337 (6.1)	577 (8.3)	311 (20.9)			
Taking precautions								
Yes	294930 (97.0)	283122 (97.6)	5166 (93.1)	5729 (82.1)	913 (61.2)	12362.086	3	<0.001
No	9237 (3.0)	7026 (2.4)	383 (6.9)	1250 (17.9)	578 (38.8)			
Self -perceived physical health								
Very good	210938 (69.3)	202322 (69.7)	3438 (62.0)	4307 (61.7)	871 (58.4)	1705.798	12	<0.001
Good	78176 (25.7)	74254 (25.6)	1574 (28.4)	1987 (28.5)	361 (24.2)			
General	14440 (4.7)	13082 (4.5)	504 (9.1)	636 (9.1)	218 (14.6)			
Poor	511 (0.2)	414 (0.1)	26 (0.5)	42 (0.6)	29 (1.9)			
Very poor	102 (0.0)	76 (0.0)	7 (0.1)	7 (0.1)	12 (0.8)			
Self-perceived mental health								
Very good	203467 (66.9)	195662 (67.4)	3145 (56.7)	3901 (55.9)	759 (50.9)	3184.494	12	<0.001
Good	78363 (25.8)	74444 (25.7)	1591 (28.7)	1993 (28.6)	335 (22.5)			
General	20771 (6.8)	18760 (6.5)	726 (13.1)	968 (13.9)	317 (21.3)			
Poor	1263 (0.4)	1056 (0.4)	73 (1.3)	94 (1.3)	40 (2.7)			
Very poor	303 (0.1)	226 (0.1)	14 (0.3)	23 (0.3)	40 (2.7)			
Sleeping quality								
Very good	114550 (37.7)	110131 (38.0)	1732 (31.2)	2216 (31.8)	471 (31.6)	2492.957	12	<0.001
Good	113388 (37.3)	109035 (37.6)	1786 (32.2)	2238 (32.1)	329 (22.1)			
General	66477 (21.9)	62339 (21.5)	1642 (29.6)	2031 (29.1)	465 (31.2)			
Poor	7649 (2.5)	6897 (2.4)	271 (4.9)	361 (5.2)	120 (8.0)			
Very poor	2103 (0.7)	1746 (0.6)	118 (2.1)	133 (1.9)	106 (7.1)			
IES level								
Normal	149090 (49.0)	143078 (49.3)	2359 (42.5)	3052 (43.7)	601 (40.3)	377.585	6	<0.001
Stress symptoms	55499 (18.2)	53098 (18.3)	973 (17.5)	1203 (17.2)	225 (15.1)			
Diagnostic PTSD	99578 (32.7)	93972 (32.4)	2217 (40.0)	2724 (39.0)	665 (44.6)			

the disease was treatable (the 'preventable and curable' group) (n = 290,148); those who thought that infection could be prevented but the disease was not treatable (the 'preventable and incurable' group) (n = 5,549); those who thought that infection was not preventable but the disease was treatable (the 'unpreventable and curable' group) (n = 6,979); and those who thought that infection was unpreventable and the disease was untreatable (the 'unpreventable and incurable' group) (n = 1,491).

Demographics and Perceptions of COVID-19

Participants who were 19–22 years old and participants who were freshers had significantly more chance of being in the 'preventable and curable' group (χ^2 = 62.359, df = 9, p < 0.001; χ^2 = 150.807, df = 9, p < 0.001). Participants who were 23–25 years old, those who were junior or senior students, those who lived in city, those who lived alone or lived with only one family member, those who had a severe physical illness, those who had a history of mental illness, and those who had a history of counseling had significantly less chance of being in the 'preventable and curable' group (χ^2 = 62.359, df = 9, p < 0.001; χ^2 = 150.807, df = 9, p < 0.001; χ^2 = 32.340, df = 6, p < 0.001; χ^2 = 41.150, df = 9, p < 0.001; χ^2 = 100.794, df = 3, p < 0.001; χ^2 = 119.474, df = 3, p < 0.001; χ^2 = 125.808, df = 3, p < 0.001). Participants whose friends, relatives or families were not infected with COVID-19 had significantly more chance of being in the 'preventable and curable' group, followed by a significantly greater chance of being in the 'preventable and incurable' group (χ^2 = 1398.378, df = 6, p < 0.001; χ^2 = 2080.461, df = 6, p < 0.001; χ^2 = 2756.788, df = 6, p < 0.001). The 'preventable and curable' group were significantly more likely to take precautions and had a significantly higher chance of having very good self-perceived physical health, mental health and sleep quality (χ^2 = 12362.086, df = 3, p < 0.001; χ^2 = 1705.798, df = 12, p < 0.001; χ^2 = 3184.494, df = 12, p < 0.001; χ^2 = 2492.957, df = 12, p < 0.001).

Participants who were male, those who were older than 26 years, those who were sophomores, those with a severe

physical illness, those who had a history of mental illness, those who had a history of counseling, and those who spent 3 h or more on reading information about COVID-19 every day had significantly more chance of being in the 'unpreventable and incurable' group (χ^2 = 210.247, df = 3, $p < 0.001$; χ^2 = 62.359, df = 9, $p < 0.001$; χ^2 = 150.807, df = 9, $p < 0.001$; χ^2 = 100.794, df = 3, $p < 0.001$; χ^2 = 119.474, df = 3, $p < 0.001$; χ^2 = 125.808, df = 3, $p < 0.001$; χ^2 = 381.506, df = 6, $p < 0.001$). Participants whose friends, relatives or families were diagnosed or suspected with COVID-19 had significantly more chance of being in the 'unpreventable and incurable' group. Those who did not know the infection status of their friends, relatives and families had significantly more chance of being in the 'unpreventable and incurable' group, followed by a significantly greater chance of being in the 'unpreventable and curable' group (χ^2 = 1398.378, df = 6, $p < 0.001$; χ^2 = 2080.461, df = 6, $p < 0.001$; χ^2 = 2756.788, df = 6, $p < 0.001$). The 'unpreventable and incurable' group were significantly more likely to take no precautions and had a significantly higher chance of having moderate, poor or very poor self-perceived physical health, mental health and sleep quality (χ^2 = 12362.086, df = 3, $p < 0.001$; χ^2 = 1705.798, df = 12, $p < 0.001$; χ^2 = 3184.494, df = 12, $p < 0.001$; χ^2 = 2492.957, df = 12, $p < 0.001$). The number of students who may be diagnosed with PTSD in the 'unpreventable and incurable' group was much higher than those in other groups (χ^2 = 377.585, df = 6, $p < 0.001$).

Participants with good self-perceived physical health and mental health had significantly more chance of being in the 'preventable and incurable' group or the 'unpreventable and curable' group (χ^2 = 1705.798, df = 12, $p < 0.001$; χ^2 = 3184.494, df = 12, $p < 0.001$). Female participants had significantly more chance of being in the 'unpreventable and curable' group (χ^2 = 210.247, df = 3, $p < 0.001$).

Associations Between Perceptions and Psychological Impact

Table 2 compares the results for psychological stress symptoms, self-perceived mental health and sleeping quality among the four groups. Levels of stress and intrusion were significantly highest in the 'unpreventable and incurable' group (χ^2 = 413.532, $p < 0.001$; χ^2 = 563.690, $p < 0.001$). Self-perceived mental health and sleeping quality were significantly poorer in the 'unpreventable and incurable' group (χ^2 = 599.833, $p < 0.001$; χ^2 = 887.284, $p < 0.001$). In sum, the comparison reveals that the 'unpreventable and incurable' group had experienced a greater psychological impact whereas the 'preventable and curable' group suffered less.

Associations Between Demographics, Perceptions, and Psychological Stress

The authors explored further the associations between psychological stress, demographic data and perceptions of COVID-19 (**Table 3**). There were main effects of perceptions on all demographics, indicating that higher IES-6 scores for 'unpreventable and incurable' group than other groups when controlled gender, history of mental illness, history of physical illness, infection condition of people around, family location, family members and daily time to read information about COVID-19, and that lower IES-6 scores for the 'preventable and curable' group than other groups when controlled demographic variables listed in **Table 3**. **Figure 1** shows these effects.

The perceptions*gender interaction was significant, $F(3,304159) = 10.958$, $p < 0.001$. The simple main effect showed that the IES-6 scores of 'unpreventable and incurable' group was higher in female than in male ($p < 0.01$), while the IES-6 scores of 'preventable and curable' group was higher in male than in female ($p < 0.001$). The perceptions*grade interaction was significant, $F(9,304151) = 5.498$, $p < 0.001$. In 'preventable and incurable' group and 'unpreventable and curable' group the difference between the fresher ($M = 7.67$, $SD = 4.27$; $M = 7.56$, $SD = 4.41$) and other grades was significantly greater. The perceptions*history of mental illness interaction was significant, $F(3,304159) = 8.642$, $p < 0.001$. The simple main effect showed that the IES-6 scores of 'unpreventable an incurable' group was significantly higher in participants with

TABLE 2 | Comparisons of psychological impact.

Variables	Preventable and curable group①	Preventable and incurable group②	Unpreventable and curable group③	Unpreventable and incurable group④	χ^2	*p*	
Item 1 of IES-6	1.47 ± 0.97	1.60 ± 1.08	1.58 ± 1.08	1.55 ± 1.21	128.198	<0.001	① < ②③④
Item 2 of IES-6	2.30 ± 1.07	2.36 ± 1.11	2.24 ± 1.13	2.06 ± 1.29	95.420	<0.001	④ < ③ < ① < ②
Item 3 of IES-6	1.38 ± 1.01	1.54 ± 1.10	1.50 ± 1.10	1.56 ± 1.21	179.374	<0.001	① < ②③④
Item 4 of IES-6	0.80 ± 0.94	1.00 ± 1.06	1.02 ± 1.07	1.21 ± 1.19	605.927	<0.001	① < ②③<④
Item 5 of IES-6	0.72 ± 0.94	0.85 ± 1.04	0.86 ± 1.05	1.08 ± 1.15	327.391	<0.001	① < ②③<④
Item 6 of IES-6	0.43 ± 0.75	0.62 ± 0.94	0.63 ± 0.92	0.90 ± 1.10	1021.087	<0.001	① < ②③<④
IES-6	7.09 ± 3.91	7.97 ± 4.51	7.82 ± 4.52	8.36 ± 5.27	413.532	<0.001	① < ②③<④
Avoidance	1.52 ± 1.63	1.84 ± 1.85	1.88 ± 1.86	2.28 ± 2.10	563.690	<0.001	① < ②③<④
Intrusion	2.84 ± 1.75	3.14 ± 1.95	3.08 ± 1.94	3.12 ± 2.16	198.165	<0.001	① < ②③④
Hyperarousal	2.73 ± 1.39	2.98 ± 1.58	2.87 ± 1.58	2.96 ± 1.87	168.956	<0.001	① < ③ < ②, ① < ④
Self -perceived mental health	1.40 ± 0.63	1.60 ± 0.78	1.62 ± 0.80	1.84 ± 1.02	599.833	<0.001	① < ②③<④
Sleep quality	1.90 ± 0.86	2.15 ± 0.99	2.13 ± 0.98	2.37 ± 1.21	887.284	<0.001	① < ②③<④

Items of IES-6: 1. I thought about it when I didn't mean to; 2. I felt watchful or on-guard; 3. Other things kept making me think about it; 4. I was aware that I still had a lot of feelings about it, but I didn't deal with them; 5. I tried not to think about it; 6. I had trouble concentrating.

TABLE 3 | Associations between psychological stress symptoms, demographic data, and perceptions of COVID-19.

Variables	Preventable and curable group	Preventable and incurable group	Unpreventable and curable group	Unpreventable and incurable group	F^a	F^b
Gender						
Male	7.33 ± 4.11	8.11 ± 4.81	7.93 ± 4.82	8.07 ± 4.46	10.958 (3,304159)***	199.812 (3,304159)***
Female	6.93 ± 3.77	7.86 ± 4.26	7.76 ± 4.33	8.74 ± 5.00		
Grade						
Fresher	7.07 ± 3.91	7.67 ± 4.27	7.56 ± 4.41	8.23 ± 5.38	5.498 (9,304151)***	206.412 (3,304151)***
Sophomore	7.13 ± 3.92	8.05 ± 4.62	7.95 ± 4.51	8.29 ± 5.10		
Junior	7.08 ± 3.92	8.11 ± 4.59	7.88 ± 4.57	8.41 ± 5.36		
Senior (4th and 5th)	7.02 ± 3.88	8.48 ± 4.71	8.31 ± 4.79	9.01 ± 5.26		
Severe physical illness						
Yes	7.66 ± 4.41	10.28 ± 5.17	8.48 ± 5.14	9.30 ± 7.12	8.642 (3,304159)***	17.047 (1,304159)***
No	7.09 ± 3.91	7.96 ± 4.50	7.82 ± 4.52	8.35 ± 5.24		
History of mental illness						
Yes	7.08 ± 4.39	8.10 ± 5.14	8.09 ± 5.01	11.71 ± 7.25	1.641 (3,304159)	11.639 (3,304159)***
No	7.09 ± 3.91	7.96 ± 4.50	7.82 ± 4.51	8.28 ± 5.19		
Infection of friends						
① Diagnosed or suspected infection	8.37 ± 4.29	9.63 ± 6.35	9.52 ± 5.53	9.42 ± 6.25	0.393 (6,304155)	31.361 (3,304155)***
② No one is infected	6.97 ± 3.87	7.78 ± 4.37	7.63 ± 4.41	8.11 ± 4.98		
③ Not sure	7.30 ± 3.98	8.17 ± 4.59	8.00 ± 4.60	8.46 ± 5.38		
Infection of relative (non co-resident)						
① Diagnosed or suspected infection	7.87 ± 4.34	8.57 ± 5.46	8.32 ± 5.41	9.22 ± 5.07	0.067 (6,304155)	11.347 (3,304155)***
② No one is infected	7.04 ± 3.88	7.87 ± 4.40	7.72 ± 4.38	8.15 ± 4.99		
③ Not sure	7.62 ± 4.23	8.50 ± 4.99	8.32 ± 5.06	8.76 ± 5.81		
Infection of family (co-resident)						
① Diagnosed or suspected infection	7.67 ± 4.23	8.86 ± 4.87	5.07 ± 4.88	9.67 ± 5.30	3.278 (6,304155)**	6.375 (3,304155)***
② No one is infected	7.06 ± 3.89	7.92 ± 4.46	7.75 ± 4.12	8.27 ± 5.09		
③ Not sure	8.06 ± 4.62	8.57 ± 5.17	8.68 ± 5.45	8.62 ± 5.91		
Taking precautions						
Yes	7.09 ± 3.91	7.94 ± 4.46	7.87 ± 4.45	8.44 ± 4.92	2.977 (3,304159)*	91.003 (3,304159)***
No	7.14 ± 4.16	8.30 ± 5.11	7.62 ± 4.83	8.24 ± 5.78		
Family location						
Rural areas	7.24 ± 0.01	8.05 ± 0.08	7.86 ± 0.08	8.18 ± 0.17	3.350 (6,304155)**	218.975 (3,304155)***
County town	7.03 ± 0.01	7.85 ± 0.10	7.74 ± 0.09	8.30 ± 0.18		
City	6.94 ± 0.01	7.98 ± 0.10	7.86 ± 0.08	8.63 ± 0.18		
Family member (co-resident)						
1–2 people	6.96 ± 0.04	7.491 ± 0.24	7.91 ± 0.22	8.35 ± 0.43	1.297 (9,304151)	116.433 (3,304151)***
3 people	6.93 ± 0.02	8.02 ± 0.13	7.86 ± 0.11	8.26 ± 0.23		
4 people	7.05 ± 0.01	7.93 ± 0.09	7.73 ± 0.08	8.38 ± 0.18		
5 people and above	7.20 ± 0.01	8.02 ± 0.08	7.87 ± 0.07	8.40 ± 0.16		
Daily time spend on reading information about COVID-19						
≤1 h	6.63 ± 0.01	7.45 ± 0.07	7.22 ± 0.06	7.69 ± 0.13	9.789 (6,304155)***	217.875 (3,304155)***
1–3 h	7.48 ± 0.01	8.50 ± 0.09	8.40 ± 0.08	8.71 ± 0.21		
≥3 h	7.93 ± 0.02	9.00 ± 0.16	9.24 ± 0.14	10.52 ± 0.26		

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. [a]Interaction test. [b]Main effect text.

a history of mental illness than participants without a history ($p < 0.001$). The perceptions*infection of family interaction was significant, $F(6,304155) = 3.278$, $p < 0.01$. The simple main effect showed that the IES-6 scores of 'preventable and curable' group was significantly lower in participants whose families were diagnosed or suspected as being infected than in participants whose families were uninfected ($p < 0.01$) and those who did not know their infection status ($p < 0.05$).

The perceptions*precautions interaction was significant, $F(3,304159) = 2.977$, $p < 0.05$. As hypothesized, the simple main effect showed that the IES-6 scores of 'unpreventable and curable' group was significantly higher in participants

FIGURE 1 | Associations between psychological stress symptoms, demographic data, and perceptions.

who had taken precautions than in participants without taking precautions ($p < 0.05$). The perceptions*location interaction was significant, $F(6,304155) = 3.350$, $p < 0.01$. The simple main effect showed that the IES-6 scores of 'preventable and curable' group was significantly higher in rural than in city ($p < 0.001$). The perceptions*reading time interaction was significant, $F(6,304155) = 9.789$, $p < 0.01$. In the group that spent 3 h or more on reading information about COVID-19 every day, the difference of psychological stress between the 'preventable and curable' group ($M = 7.93$, $SD = 0.02$) and 'unpreventable and incurable' group ($M = 10.52$, $SD = 0.26$) was even greater ($p < 0.001$).

DISCUSSION

Having spread to countries outside of China, COVID-19 has become a global threat. The rising numbers of cases and deaths, coupled with widespread quarantine measures, have the potential to create and spread fear, panic and distress among the general public. Guangdong was the second worst-affected province in China with more than 1,600 confirmed cases. After the Ministry of Education issued a notice on the postponement of the spring semester in Guangdong, it was thought that students might face a psychological challenge. Plans for interventions during public health emergencies such as the COVID-19 epidemic need to be based on an understanding of the factors related to the occurrence of mental health problems in this specific group.

The results of our cross-sectional study showed that 155,077 (50.9%) of the students surveyed reported stress symptoms, 1,565 (0.5%) reported poor mental health, and 9,752 (3.2%) reported poor sleep quality, which indicates that a substantial proportion of the students were distressed. Although quarantined students experienced PTSS symptoms, the scales that were used to measure these symptoms were not sufficient to confirm a diagnosis of PTSD. To confirm such a diagnosis, structured diagnostic interviews would have been required. As the survey was anonymous, this was not possible. An average score of $\geq$1.09 on the IES-6 scale was used to estimate the prevalence of PTSS in our study. While other cutoff points might have been used to estimate PTSD, the important findings of this study are the risk factors that were identified as likely to increase PTSS, rather than the absolute prevalence of PTSD.

In the face of a large-scale epidemic, media broadcasts are one of the most effective methods of reducing epidemic-induced panic. On the one hand, media broadcasts have provided people with sufficient information for a good understanding of the prevalence of COVID-19 and its nature. In China, official departments strove to improve the public's awareness of prevention and intervention strategies by providing daily updates about surveillance and active cases on websites and social media (Bao et al., 2020). On the other hand, many self-publicists and netizens also release and recirculate related information which might include misinformation and rumors on social media, such as WeChat and Weibo, which can also lead to (mis)information overload (Bontcheva et al., 2013) and subsequently give rise to mental health problems. In addition, because people paid attention to the information that was updated daily with new cases and fatalities, the severity of COVID-19 was reinforced and the level of public panic was heightened. This might explain the varying risk perceptions of COVID-19 in our results, and also explain that the psychological stress significantly increased when participants read relevant information for 3 h or more per day.

This study showed that reading COVID-19 relevant information for 3 h or more every day was more likely to have negative perception. Similar to our results, a study focused on the MERS outbreak in South Korea showed that social media exposure might have been positively related to the formation of risk perceptions during the outbreak (Choi et al., 2017). Leppin and Aro (2009) suggested that in the first stage of the SARS outbreak risk perception was strongly influenced by the nature of the hazard and the way that the media reported on the cases and fatality incidents. The current study of more than 300,000 students found that 290,148 (95.4%) of the sample considered COVID-19 as preventable and curable, 6,979 (2.2%) considered it as unpreventable but curable, 5,549 (1.8%) considered it as preventable but incurable, and only 1,491 (0.5%) considered it as unpreventable and incurable. Overall, it seems that the students tended to have a more positive mindset after the occurrence of the COVID-19 outbreak; however, around 50% of the students showed stress symptoms. It is worth noting that students in the 'unpreventable and incurable' group were the least likely to take precautions. In terms of psychological processes, one explanation for the diversity of responses is that in some populations a very high risk perception, rather than mobilizing people to take action, might evoke a sense of helplessness which could paralyze rather than stimulate protective behaviors. For threats like a pandemic, the effectiveness of countermeasures must remain unclear in the initial absence of a vaccine, such that no-action responses might be particularly prone to occur (Leppin and Aro, 2009).

A significant association was noted between the occurrences of stress symptoms and perceptions of COVID-19. The 'unpreventable and incurable' group had the higher stress levels and a higher prevalence of the symptoms that may indicate a PTSD diagnosis. Additionally, a significant connection was found between self-perceived mental health and perceptions of COVID-19, and also between sleep quality and the perceptions. The 'unpreventable and incurable' group had the poorest mental health levels and the poorest sleep quality. Research has found that a higher perceived risk of being infected by coronavirus and a higher perceived level of harm led to significantly higher anxiety levels among the general public in China (Qian et al., 2020), suggesting that risk perceptions of COVID-19 can affect the mental health of a general population. In the current study, negative perceptions could have made the epidemic seem more catastrophic and high-risk, which in turn made students feel helpless and led them to underestimate their ability to cope. Such consequences are more likely to cause psychological stress. Other research on the stress caused by epidemic diseases has revealed that the perception of SARS played a mediatory role between stress caused by external sources and emotional and behavioral responses (Qian et al., 2005). Moreover, the current study also found that the 'unpreventable and incurable' group had a higher possibility of experiencing epidemic-related stress

events (such as infection or suspected infection with COVID-19 in friends, relatives and families), as well as a higher possibility of susceptible factors (such as severe physical illness, poor physical health, a history of mental illness or a history of counseling), which means that all those who had encountered stress events or exhibited susceptible factors had higher stress levels. Hence, since the 'unpreventable and incurable' group also suffered from their physical illness, mental impact, or epidemic events, they were more likely to experience stress symptoms. In addition, a tendency toward an optimistic bias should influence perceptions so that personal ratings are generally lower than those for the overall population (Leppin and Aro, 2009), which could be another explanation for the 'preventable and curable' group having lower psychological stress levels.

Further analysis revealed that there was an interaction between demographic characteristics and perceptions of COVID-19. The demographic characteristics influenced the relationship between perception types and levels of stress symptoms. More females than males perceived COVID-19 to be 'unpreventable and curable,' whereas more males than females perceived COVID-19 to be 'unpreventable and incurable.' There was an interaction between gender and perception. We found that females with an 'unpreventable and incurable' perception suffered more of a psychological impact than men with the same perception, suggesting that females are much more vulnerable to stress. These results are in accordance with previous research which found that the level of stress and psychological distress is higher in female than in male college students (Backović et al., 2012; Saleh et al., 2017; Gao W. et al., 2020). During the COVID-19 epidemic, the emotional response index for females was found to be higher than that for males (Qiu et al., 2020). Other research found that females were more easily worried than males about being infected during an epidemic and were more fearful that the epidemic was hard to control (Furer et al., 1997), suggesting that if females think that COVID-19 infection can't be prevented, the worry will be more obvious, which may explain why the females with an 'unpreventable and incurable' perception suffered more of a psychological impact. On the other hand, some studies of stress among students found that male students reported higher stress levels than females (Shashidhar, 2003; Ahern and Norris, 2011). In the current study, we found that the males with the 'preventable and curable' perception suffered more of a psychological impact than the females with the same perception. This may be because females are more likely than males to expect and accept the help of others; when disasters occur, females are more likely to be positively affected by the social support systems that might provide them with relief from psychological stress (Liu et al., 2004).

Young people tend to obtain a large amount of information from social media which can easily trigger stress if too much time is spent on information about the corona epidemic. Perceived risk of infection and perceived severity of the disease as well as information reliability were found to be important factors associated with the psychological and behavioral responses of people in China (Qiu et al., 2020). Research on psychological stress among college students of different ages has indicated a positive correlation between psychological stress and age (Fornes-Vives et al., 2012; Voltmer et al., 2012). Our results were similar to these research in finding that younger students and freshers were relatively more optimistic about their perception of the disease and had lower stress levels during the COVID-19 epidemic. On the one hand, the consideration that the highest mortality rate was occurring among the elderly might have led younger people to have more confidence in their autoimmunity and to have better psychological tolerance for such emergencies. On the other hand, higher-grade students might have entered a reflective and confused period, and have a higher self-awareness of their health and future. Due to the impact of the epidemic, senior students in particular will face a series of problems and stresses, such as difficulties in progressing a graduation thesis, delays in graduation and anxieties about employment. It was also found that there was a higher risk of depression during COVID-19 among those aged 21–40 years compared to those who were under 20 (Gao J. et al., 2020).

Participants with a severe physical had a more negative perception of COVID-19 and were more vulnerable to psychological stress in the two preventable groups. This may be related to a higher mortality rate for people with a previous medical history and lower immunity. Judgments on the personal likelihood of contracting an infectious disease are subject to considerations of individual immune competence and host resistance. There was no difference between the two unpreventable groups in the levels of psychological stress, which were related to students' perceptions of the virus and their demographic characteristics. Students who believe that COVID-19 infection is not preventable, regardless of physical illness, may feel that they have the same probability of contracting pneumonia. The manifestation of this panic mood may be related to the body's normal protective response to the stress caused by an epidemic (Maunder et al., 2003). A cognitive appraisal framework assumes that it is mostly perceptions that give rise to emotions (Roseman, 1996). In the case of a long-term chronic disease, emotions such as fear are likely to be less imminent and therefore secondary to more rational reflections about gains and losses related to protective behavior. However, in an acute threat situation such as an influenza pandemic, emotional aspects might gain a more immediate importance. This is all the more likely if, during the early stages of an outbreak, experts are unable to make more than tentative statements and provide partly contradictory prognoses and recommendations. Unlike the individual long-term development of a chronic disease, where there is an extended timeframe for changes in behavior, an outbreak situation creates a massive, collective and acute threat, and people tend to feel more out of control (Leppin and Aro, 2009). Besides, this study revealed that there was an interaction between mental illness history and perceptions of COVID-19, participants with mental illness were significantly more vulnerable to psychological stress in 'unpreventable and incurable' group. This may be related to the lower psychological resistance and higher susceptibility of participants with a history of mental illness. Negative perception will further aggravate low psychological resistance and high susceptibility, which would have led to worries about being infected with COVID-19.

The interaction between perceptions and family location was significant. In 'preventable and curable' group, students living in city had lower psychological stress than students living in rural during COVID-19. Likewise, a study has found that living in urban areas, in contrast to rural areas, was protective factor against anxiety of college students (Cao et al., 2020). This might be explained by the imbalance of economic, cultural, and educational resources between urban and rural areas. The urban economy is relatively prosperous and provides citizens with better material security. Similarly, the sanitary conditions in cities are better than in towns and villages, which decreases the chances of surviving the virus. Cities also have excellent educational resources, and they have made great efforts to publicize knowledge on how to prevent the epidemic, which attracts attention to the measures taken to stop the epidemic.

PTSD is an anxiety disorder that is characterized by avoiding stimuli associated with traumatic events, by re-experiencing the trauma (intrusion), and by hyperarousal. This disorder may develop after exposure to traumatic events that involve a life-threatening component, and if the trauma is perceived to be a personal assault the vulnerability of the person to developing PTSD may increase (Breslau et al., 1998; Pietrzak et al., 2014). The presence of more stress symptoms in students acquainted with friends, relatives or families who were confirmed or suspected as being infected with COVID-19 may indicate a greater perceived self-risk, compared to students who did not have this personal connection. In contrast, students in the 'unpreventable and curable' group whose families were diagnosed or suspected of infection suffered less stress than students who had no family infection. The principle of consistency states that when two or more simultaneously active cognitive structures are logically inconsistent, arousal is increased, which activates processes with the expected consequence of increasing consistency and decreasing arousal (Kampen, 2019). Brown (2005) pointed to belief modification as a means of reducing cognitive dissonance, which might cancel out any protective motivational impulses of risk appraisal. We speculate that students who perceived COVID-19 infection to be unpreventable would be more fearful of becoming infected. When faced with infection in the family, which increased the degree of perceived self-risk and panic, students modified their cognition in order to reduce emotional arousal. Students rationalized and accepted the fact that members of their family were infected by persuading themselves that COVID-19 is not preventable, and they had confidence that their families could be cured. After this cognitive disruption, there was less psychological stress in the attempt to reduce dissonance.

In the two preventable groups, the level of psychological stress was slightly lower among students who took precautions than those who did not, although the results were not significant. In contrast, as hypothesized, in the two unpreventable groups, the level of stress was higher in the students who took precautions, and there was a significant difference in the 'unpreventable and curable' group. The theory of cognitive dissonance often involves an inconsistency between an individual's existing attitude and their behavior in a certain social context, which has been described as an aversive motivational state (Brown, 2005). Students who believed that COVID-19 infection was unpreventable took precautions because of a high level of anxiety, and this inconsistency between cognition and behavior (i.e., cognitive dissonance) led to higher levels of psychological stress. In order to alleviate this pressure according to the principle of consistency, adjusting students' perception of unpreventable COVID-19 would be an effective method.

A web-based survey was conducted to assess the psychological stress levels among students during the COVID-19 outbreak in Guangdong. This approach has several advantages—in particular, high efficiency and low cost. The major limitations of the survey are, firstly, the lack of information about the non-respondents. There may be selection bias, and as all the data were self-reported the results may reflect a social desirability bias. However, systematic differences between respondents and non-respondents cannot be ascertained accurately. This might limit the interpretation of the results, but the large sample size can compensate for this. Secondly, our study was a cross-sectional design and it is difficult to make causal inferences. People were likely to experience four emotional phases or responses during the outbreak: shock/disbelief; a strong emotional response; acceptance; and recovery (Kowalskia and Kalayjian, 2001). Our study was conducted during the first stage of the outbreak, when students' perceptions might have been strongly influenced. Future research may continue to detect changes in students' perceptions at different stages of the epidemic. Thirdly, we assessed only the psychological stress levels of college students in Guangdong province after the COVID-19 outbreak (the worst-affected province after Hubei), which limits the scope of the conclusions.

Despite these limitations, the results of this survey allow for the generation of hypotheses that require further exploration. The results demonstrate the psychological impact on college students when faced with a severe infectious disease, and show that negative perceptions can result in considerable psychological distress in the form of PTSD symptoms. A review of longitudinal studies found that during the initial phases of the SARS outbreak in 2003 risk perception showed a steady increase and only stabilized in later phases (Qian et al., 2020), which suggests that the psychological impact on students will continue for a period of time. Public health officials, infectious disease physicians, psychiatrists and psychologists need to be made aware of this issue. They must be prepared to provide additional support to students who are at increased risk of the adverse psychological effects when the COVID-19 broke out and students were quarantined instead of attending school.

Our findings also yield several important public implications. Firstly, providing the students with reliable, accurate and acceptable information is crucial for addressing the psychological effects of contagious disease outbreaks. Students' negative perceptions of whether the disease could be treated and infection prevented might have led to significantly sustained psychological stress. Media companies should manage scientifically the information that they release, focus on learning more about the psychological changes in the general public, and determine whether the public can accept the information when publishing.

Additionally, media companies and related organizations need to combat "infodemics" using a variety of strategies, including monitoring and filtering out misinformation, clarifying rumors and conducting live Q&A interviews with experts. Secondly, colleges and universities should launch psychological counseling services in a timely manner and establish a system of online psychological assistance to enable students with severe psychological stress to adjust their mental state in a timely manner and to maintain a basic psychological balance. This study provides a basis for understanding the characteristics of students suffering psychological stress as a result of a public health emergency. Colleges and universities could provide targeted psychological services for different characteristics of the student population. At the same time, it is important to note that the focus of the assistance should be different during different stages of an epidemic. In the early stage, the assistance should focus on psychological stress. As the epidemic develops, the service should focus on psychological and behavioral disorders, alerting students to the potential disorders caused by the epidemic, such as phobias, anxiety and depression. Students with an obvious psychological impact in the early stage may be the focus for later evaluation, psychological assistance, and a short-term and long-term follow-up. Lastly, in the future, health education courses for common disasters could be established in colleges and universities to enhance the normal stress resistance of college students against disasters and encourage them to be a backup force for health education in the event of future disasters.

CONCLUSION

To conclude, college students' perceptions of COVID-19 were correlated with psychological stress, self-perceived mental health and sleep quality. And the degree of stress also varied with types of perception. Secondly, as hypothesized, the study found that when students' behavior was inconsistent with perception, the psychological impact was higher than students whose behaviors were consistent with perception. Furthermore, as this is the large sample study on the immediate perceptions of COVID-19 among college students, understanding these factors will help us to design intervention programs with the aim of alleviating stress among students.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the dataset involves 85 colleges and universities, and sharing requires the approval of all schools. Requests to access the datasets should be directed to JZ, mingtian@smu.edu.cn.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the institutional ethics board of Southern Medical University. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

JZ designed the study. XL, RC, JC, SL, and ST participated in the data collection and analysis, and writing and revising the manuscript. SL and LL participated in the writing and revising of the manuscript. All authors contributed to the article and approved the submitted version.

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OPINION
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Alone With the Kids: Tele-Medicine for Children With Special Healthcare Needs During COVID-19 Emergency

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The Coronavirus Disease of 2019 (COVID-19) is a contagious respiratory illness (Sohrabi et al., 2020) that following an initial outbreak in China is rapidly spreading worldwide. New positive cases are increasingly identified in a growing number of countries and the emergency has been recognized as a global pandemic (Coccia, 2020). To face and cope with such an unprecedented healthcare emergency, National governments have adopted specific strategies to limit the large-scale impact of the contagion (Parodi and Liu, 2020; Remuzzi and Remuzzi, 2020). Despite between-country differences exist (Chintalapudi et al., 2020; Roux et al., 2020; Tarrataca et al., 2020), these measures have generally changed from the initial attempts of containment to the subsequent mitigation actions. Lockdown acts have been largely adopted to slow the virus spread, to reduce the demands of intensive healthcare, and to control the contagion rate in the medium-long period (Parodi and Liu, 2020).

THE FRAGILE CONDITION OF FAMILIES OF CHILDREN WITH DISABILITY DURING THE COVID-19 EMERGENCY

In this setting, the direct and indirect implications for citizens and healthcare specialists have been largely highlighted (Barello and Graffigna, 2020; Barello et al., 2020; Tian et al., 2020; Wang et al., 2020). Fragile and at-risk people—such as children with neurodevelopmental disabilities and their parents—are especially exposed to psychological stress related to the Covid-19 contagion and the lockdown (Provenzi and Tronick, 2020; Provenzi et al., 2020). A major consequence of the lockdown was the suspension of psychological and rehabilitation services for the healthcare and educational needs of children with neurodevelopmental disability (Schiariti, 2020; Thompson and Rasmussen, 2020). Although these children may present with different clinical conditions—e.g., autism spectrum disorders, psychomotor delay, genetic disorders and rare syndromes—they all share common special healthcare needs that require intensive interventions (Wilson et al., 2014; Järvikoski et al., 2015; Giusti et al., 2018).

Italy was hit first by the Covid-19 emergency among European countries (Remuzzi and Remuzzi, 2020) and—at the present moment—the count of positive cases is second only to the United Kingdom. Consistently, the Italian government faced the rapid and partly unexpected rise of the Covid-19 emergency with limited scientific, social and economic references. After the adoption of mitigation strategies characterized by general services lockdown, both public and local initiatives have recognized the needs of the most fragile individuals and specific supportive services have been developed (Boldrini et al., 2020; Leocani et al., 2020). Nonetheless, greater efforts are needed to meet the needs of the families of children with disability (Amaral and de Vries, 2020).

Following the lockdown, parents of children with the most severe neurodevelopmental conditions and with limited autonomy in daily activities may feel that they are left alone in caring for their kids (Dalton et al., 2020; Thompson and Rasmussen, 2020). The suspension of daily rehabilitation services and the lack of alternative recreational opportunities leave these parents alone in caring for their children, with the burden of balancing their psychosocial resources between caring for their child special needs and accomplishing their job duties. These families have to reinvent their own space and time organization, trying to find new ways to deal with their own needs and those of their children. Additionally, they may partially or completely lack the support of specialists—e.g., psychologists, educators, rehabilitation professionals, social workers—with which they are used to engage and from which they expect to receive solutions and relief.

FAMILY-CENTERED TELE-MEDICINE INTERVENTIONS: BRIDGING PHYSICAL DISTANCING AND ASSURING CONTINUITY OF CARE FOR CHILDREN AND PARENTS

We live in a world where physical distances can be easily bridged by using telecommunication devices such as personal computers, smartphones, and tablets. In order to encounter and appropriately respond to the needs of parents of children with special healthcare needs, specialists should invest energy and resources in tele-medicine tools and strategies (Choon-Huat Koh and Hoenig, 2020). At the same time, policy makers and hospitals are requested to invest in interventions based on tele-medicine in order to manage the suspension of outpatient services and provide continuity of care (Veerapandiyan et al., 2020). The flexible nature of the technological support allow researchers and clinicians to develop tailored solutions that can serve different scopes: from assessment to intervention and from parent- to child-focused activities (**Figure 1**). The use of remote consultations, for example, both in the audio or video format, may be used for children behavioral assessment (Schopp et al., 2000; Barretto et al., 2006) and to communicate closeness, compassion and comprehension to parents while assuring quality of care, even if in the context of mobility constraints (Follmer et al., 2010; Vismara et al., 2013, 2018). Professionals can also share with the parents videotapes of intervention and rehabilitation sessions that they previously registered with the child, in an effort to provide visual examples and hints about how to pursue a continuation of care at home (Sourander et al., 2016). Specialists and parents can also use remote internet connections to share and co-create tools and materials to better explain the present COVID-19 situation to children with psychomotor delay or intellectual disability (Camden et al., 2019). Digital versions of augmentative alternative communication symbols may allow adequate access to COVID-19-related information to children with language impairments. Similar *ad-hoc* materials should be created and shared openly with the rehabilitation community (Langkamp et al., 2015). Telephone and video-chat connections can also serve the scope of providing parents and older children with psychological support. As the quality of caregiving and parental well-being are known to associate with children development (Roggman et al., 2013; Totsika et al., 2020), providing tailored parental support during tele-medicine interventions should be considered as a key element of the intervention itself. Notably, tele-medicine interventions can also facilitate the direct provision of rehabilitation programs for older children that can benefit from the on-line availability of therapeutic games and apps which can also provide the therapists with an ongoing monitoring of the rehabilitation journey (Corti et al., 2018; Oldrati et al., 2020).

Such a family-centered approach to tele-medicine in child neuropsychiatry is warranted to provide positive effects for both children and families (**Figure 2**). On the child-side, by promoting continuity of care the risk of disrupting daily and weekly routines is reduced and children can maintain social and affective contacts with their therapists and specialists. Moreover, on-line rehabilitation programs can support the achievement of developmental milestones in behavioral, cognitive and social abilities (Langkamp et al., 2015; McConnochie et al., 2015; Knutsen et al., 2016). As parents' role in facilitating the rehabilitation interventions is much more prominent in online interventions, they can be more actively engaged by therapists (Myers et al., 2017; Ray et al., 2017). Additionally, parents can receive psychological and educational support to meet their own needs and those of their children (Harper, 2006; Hinton et al., 2017). Finally, by actively engaging in remote therapies and rehabilitation sessions they can increase their sense of agency and self-efficacy in parenting.

INSIGHTS FROM AN ONGOING ITALIAN FAMILY-CENTERED TELE-MEDICINE PROGRAM DURING THE COVID-19 LOCKDOWN

Soon after the start of the lockdown phase in Italy, a family-centered tele-medicine program—namely, the Engaging with Families in On-line Rehabilitation of Children during the Epidemic (EnFORCE) program—was launched at the Child Neurology and Psychiatry Unit of the IRCCS Mondino Foundation, in Pavia. This hospital is located in the primary hotspot of Covid-19 spread in Italy and receives patients from the surrounding Lombardia region as well as from other regions. The EnFORCE program was aimed at providing families of children with neurodevelopmental disabilities that were already enrolled in outpatient activities with an immediate tele-medicine support, reducing the risk of emotional distress and psychological burnout during the lockdown phase. The majority of rehabilitation interventions that were planned or ongoing for the physical

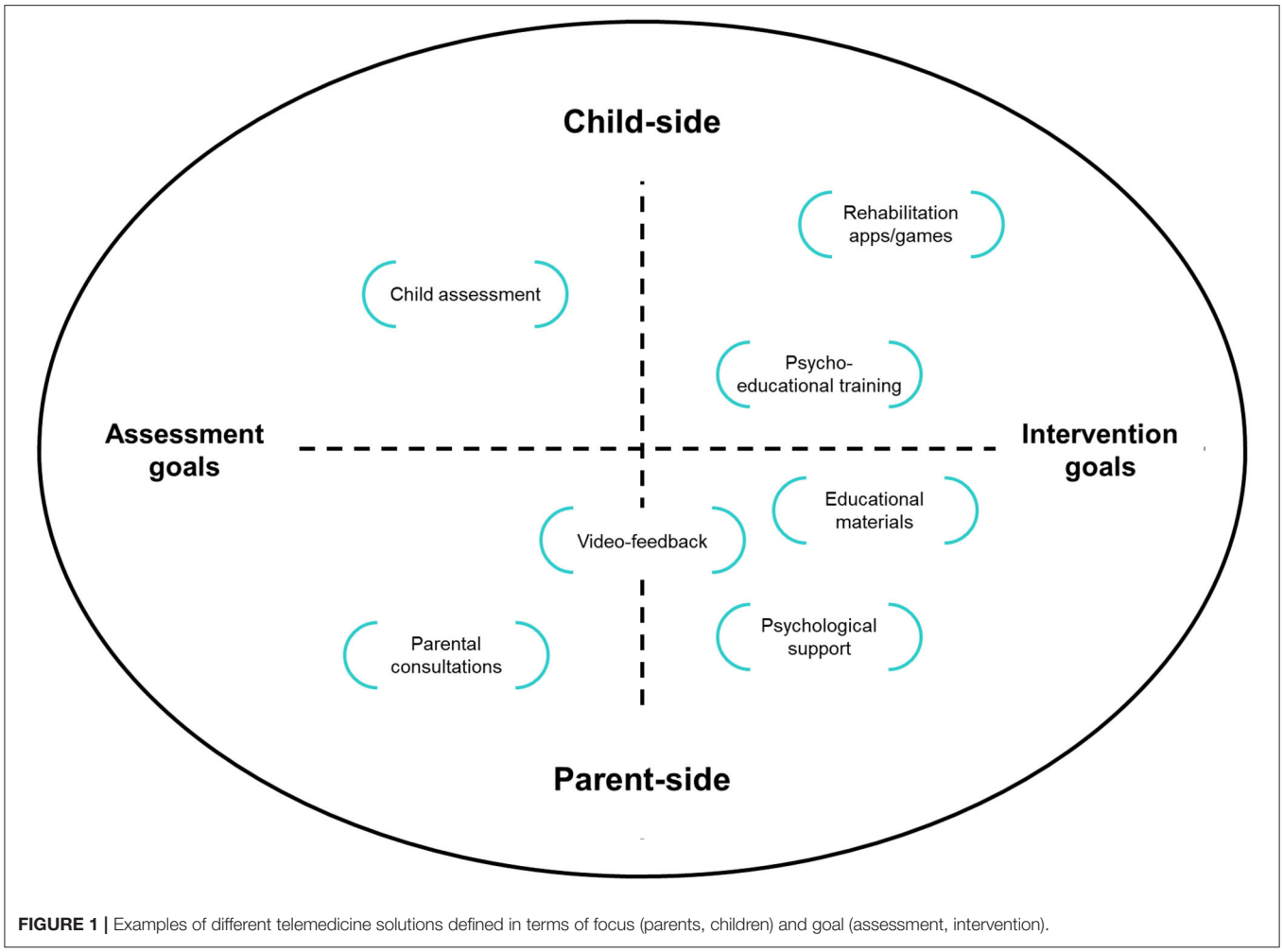

FIGURE 1 | Examples of different telemedicine solutions defined in terms of focus (parents, children) and goal (assessment, intervention).

setting were modified in order to be at least partially delivered on-line, engaging parents and promoting a positive rehabilitation partnership with therapists and healthcare professionals. The primary aim was promoting continuity of care for children; nonetheless, a secondary goal was providing emotional and psychological support to the parents during an unprecedented challenging time. More than 80 families were enrolled in the study. The preliminary findings suggest that although none of the included parents had been positive to Covid-19, half of them were living in a high-contagion rate geographical area and up to 20% had experienced the loss of a loved one. Concerns for the child health and the continuity of rehabilitation programs were among the greatest sources of emotional distress for these parents, confirming the psychological burden of lockdown in families of children with disability. At the present moment, the intervention is ongoing and data on the reduction of parents' psychological burden are not available. Nonetheless, all the eligible families accepted to be enrolled in the intervention with almost 100% of participation to the on-line sessions, which suggests that the EnFORCE program was well-received by parents.

CHALLENGES FOR FAMILY-CENTERED TELE-MEDICINE

Tele-medicine implies also some specific critical aspects to manage. First, relevant challenges regard the security and safety of data management and families' privacy. Tele-medicine intervention require the shift of data storage and access on cloud services. While this has the advantage of being convenient (e.g., complete patient history can be available in real-time) and cost-effective (Esposito et al., 2018), cloud deployments in healthcare industry are vulnerable to threats posed by both external attacks and service providers. Cryptographic systems, such as block-chain technology, offer flexible and efficient solutions (Guo et al., 2019). Moreover, policies for data management security and protection differ between countries. The regulation concerning data ownership and datacentre locations can be conflicting in different states and even within the European Union there may be different degrees of control and limitations to healthcare data storage, sharing and management (Currie and Seddon, 2014; Esposito et al., 2018). Second, although smartphones, computers and tablets are thought to be generally available to

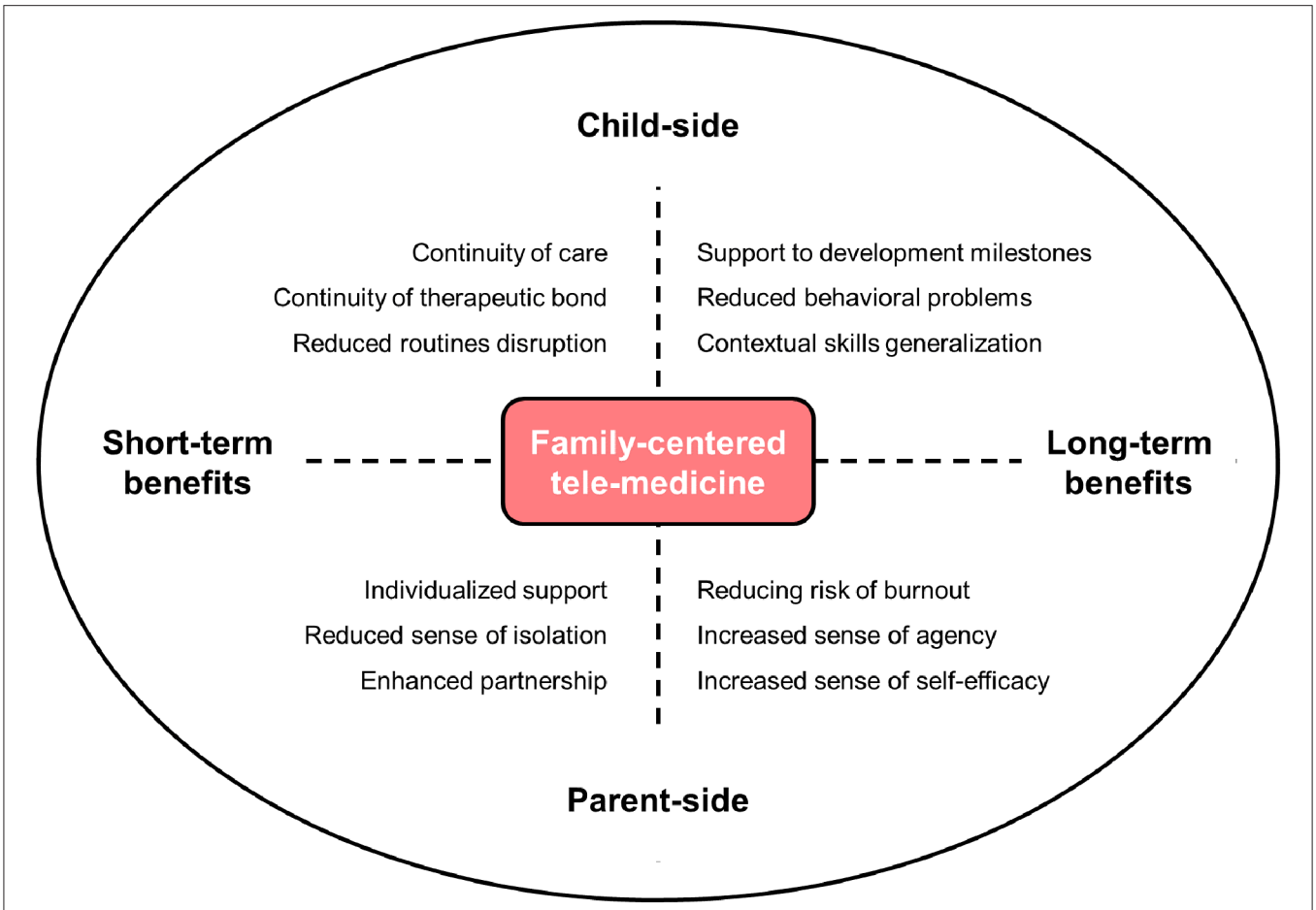

FIGURE 2 | The potential benefits of family-centered tele-medicine for parents of children with neurodevelopmental disabilities. The horizontal axis represents the time frame of benefits, whereas the vertical axis represents the different positive effects for the parents and the child.

most of the families, demographic data only partially support this common sense view. A recent survey conducted in the biennium 2018–2019 by the Italian National Institute of Statistics (ISTAT)[1] revealed that approximately the 33% of families had no computer or tablet at home; this estimates was lower (14%) for families with at least one child. Only 22% of families had a one-to-one member-device ratio and families with low socio-economic status were especially lacking the availability of computers and tablets. With the growing digitalization of healthcare (Mishon et al., 2020; Moro Visconti and Morea, 2020), the availability of technological devices in home environments becomes a key requirement for accessing healthcare services and governments need to provide adequate economic support to promote equality and reduce socio-economic disparities. Finally, the rehabilitation materials and methods need to be at least partially adapted to the tele-medicine settings. This adaptation also regards the specialist-parent relationship. Indeed, clinicians usually have a primary role in the direct management of the rehabilitation activities, while parents are often left on the bench. In tele-medicine settings, the therapists are outside of the family physical space and the development of an optimal partnership with the parents becomes both a key goal and a crucial proxy for the success of the rehabilitation program itself.

CONCLUSIONS

The COVID-19 pandemic is asking specialists in the field of child neuropsychiatry and rehabilitation to at least partially shift to tele-medicine programs. Nonetheless, this unprecedented period of healthcare and socio-economic crisis can also become an opportunity (Provenzi and Barello, 2020). Indeed, by improving our ability to use innovative technologies to respond to the special healthcare needs of children with disability and their families, we may proceed forward to build more inclusive societies and smarter healthcare systems. In other words, tele-medicine strategies in developmental neuropsychiatry should not be considered as an emergency response only. Rather, as tele-medicine makes healthcare services accessible by underserved and resource-constrained communities (Andreassen and Dyb, 2010; Khilnani et al., 2020), this is an unmissable occasion to create new bridges to reduce inequalities in healthcare for children and families. Even when we will be able to consider

[1]Data retrieved here: https://www.istat.it/it/archivio/240949.

this emergency passed, tele-medicine solutions are warranted to be a positive heritage of our virtuous response to the current pandemic.

AUTHOR CONTRIBUTIONS

LP conceived the initial draft of this work. SG drafted the final version of the work. RB provided scientific supervision. All authors contributed to this work and agreed on the submission of the final manuscript version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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BRIEF RESEARCH REPORT
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Influence of COVID-19 on the Perception of Academic Self-Efficacy, State Anxiety, and Trait Anxiety in College Students

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The worldwide pandemic situation caused by coronavirus disease 2019 (COVID-19) has led to a state of confinement of the population, which has caused, following consulted research, an increase in stress. Faced with this situation, the Spanish university not only had to adapt to the changes derived from the causes of the pandemic but also had to face a new methodological model—e-learning teaching—for which not all teachers and students were prepared. This could cause an increase in stress due to the uncertainty caused by this time of change. This research analyzes the relationship between perceived self-efficacy in the confinement period and the level of trait anxiety (TA) and state anxiety (SA) during COVID-19. Four hundred twenty-seven students from the University of Granada (Spain) participated in this study. The adaptation of two scales that measure perceived academic self-efficacy and anxiety (TA and SA) has been applied. The results indicated that there was an inversely proportional relationship between anxiety and self-efficacy; men showed the highest perception of self-efficacy, while women had higher scores in TA and SA; the latter was accentuated in cases when a relative died. To conclude, students who show a higher level of anxiety (TA and SA) express more negative emotions and also perceive themselves with less academic self-efficacy. Therefore, a stressful situation (pandemic and confinement) together with a critical event (illness and death of a relative/friend due to COVID-19) increases anxiety levels and influences the perception of academic self-efficacy.

Keywords: COVID-19, perceived academic self-efficacy trait anxiety, state anxiety, higher education, health sciences

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INTRODUCTION

March 2020 in Spain, the first period of the state of alarm caused by coronavirus disease 2019 (COVID-19) was declared. This led to the confinement of the population.

Among the containment measures adopted in the university field was the suspension of face-to-face educational activity. As a result, a more online-focused delivery of education was considered. This change affected more than 89.4% of higher education institutions in European countries, Argentina, and Russia (Marinoni et al., 2020). García-Peñalvo (2020) indicated that, although

the digitization of the Spanish university began a decade ago, we have focused on face-to-face teaching. However, in this time of isolation, it is necessary to integrate technology into classrooms (Mingorance et al., 2019). But any change generated many uncertainties in the university context. Thus, not attending face-to-face lessons made the American students worried, nervous, and anxious; therefore, 75% of them would like to go back to face-to-face interactions (Kelly, 2020).

Confinement, fear of the unknown, and all these changes caused by the health situation of COVID-19 have increased negative emotions in the Peruvian population, which might harm mental health (Huarcaya-Victoria, 2020). According to Ozamiz et al. (2020), in their research within the Spanish population, at the moment, it is difficult to know the psychological and emotional consequences of this situation, but it is evident that they can lead to anxiety disorders, depression, stress, and increased consumption of harmful substances (Asmundson and Taylor, 2020; Ozamiz et al., 2020; Shigemura et al., 2020; Torales et al., 2020; Valiente et al., 2020; Wang C. et al., 2020).

Other investigations delved into the effects of infectious diseases, such as the research carried out by DiGiovanni et al. (2004) about the severe acute respiratory syndrome (SARS) virus in Toronto, Li et al. (2011) about the H1N1 virus or influenza A in Chinese university students, Taylor et al. (2008) about equine influenza in the Australian population, and Tucci et al. (2017) about the Ebola virus in Occidental Africa and the Zika virus in Brazil and Puerto Rico. They concluded that, during this pandemic situation, the risk of psychological problems increased in the population. Due to the nature of the virus and the fact that is very contagious, among other reasons, the general Chinese population experienced these situations with an increase in anxiety, depression, and other stress reactions (Wang Y. et al., 2020), incrementing psychological anguish if there was a loss of a relative (Mohammed et al., 2015; Ho et al., 2020), results obtained in Chinese and Nigerian populations.

The university environment is not exempt from all these factors. Focusing on the Science, Technology, Engineering and Mathematics (STEM) student body in the United States, these new circumstances originating from COVID-19 was joined to the many demanding aspects of this educational stage, such as academic success (Hall and Sverdlik, 2016). Azad et al. (2017) and the American College Health Association (2019) reported that, faced with the pandemic situation, Turkish and American university students, respectively, had a high risk of suffering anxiety, depression, and panic attacks; these were the most common disorders. In addition, having someone close diagnosed with COVID-19 increased the risk of higher anxiety levels in Chinese population (Cao et al., 2020).

Furthermore, the university context is potentially stressful, and the situation generated by COVID-19 could have a negative impact on students. Although there is little research that analyzes the impact of the pandemic on Chinese students and its influence on academic expectations, some studies concluded that 21.3% of Medicine students showed mild anxiety, 2.7% moderate anxiety, and 0.9% severe levels of anxiety. Having relatives or acquaintances infected with COVID-19 was a risk factor (Cao et al., 2020). In the survey to college students conducted by the American College Health Association (2019), data indicated that 26% of college students reported feeling very depressed compared to 43% who indicated that they were overwhelmed by anxiety. But in addition, the situation of isolation increased psychological pressure (Xiao, 2020); the symptoms persisted even after the confinement (Pfefferbaum and North, 2020).

Regarding the psychological impact, Li et al. (2020) reported that 28.8% of the Chinese respondents suffered anxiety symptoms from moderate to severe and 8.1% responded that they had stress levels (from moderate to severe); Chinese and Canadian women suffered from higher levels of stress, anxiety, and depression (Cao et al., 2020; Taylor et al., 2020). In the same line, Vera-Villaroel (2020) indicated that the stress generated by the global pandemic was related to anxiety, and women presented higher levels than men (Gutiérrez-García and Landeros-Velázquez, 2018). During the COVID-19 crisis, 7% of the general Chinese population suffered symptoms of depression (Kang et al., 2020), increasing anxiety, depression, and outrage (Dubey et al., 2020).

Furthermore, anxiety is indirectly related to academic performance and directly related to the perception of academic self-efficacy (Gutiérrez-García and Landeros-Velázquez, 2018). Therefore, 29% of the Spanish university students with a high level of stress had low levels of self-efficacy (Navarro-Mateu et al., 2020). In this line, anxiety was negatively related to academic self-efficacy (Gutiérrez-García and Landeros-Velázquez, 2018) and positively to state anxiety (SA) in Nigerian university students (Onyeizugbo, 2010).

On the other hand, the perceived academic self-efficacy in the academic environment and the performance of university students are factors that are positively related. This is stated by Colom (2012) and Ahmadi (2020) who found that Iranian students' self-perceptions about their own ability and competence to perform a certain task is significantly associated with academic performance. A subsequent study confirmed the influence that academic self-efficacy and emotions have on the academic success of university students. Thus, higher levels of positive emotionality were related to higher levels of success (De la Fuente et al., 2019).

At the academic level, academic self-efficacy was related to performance and indirectly influenced academic aspirations (Ahmadi, 2020). In addition, the stress generated by the academic context (overload of tasks, pressure due to work, frequent evaluations, and the pandemic situation, among others) could lower expectations of self-efficacy. Thus, 29% of students with high levels of stress showed low levels of self-efficacy, concluding that there is an inversely proportional relationship (Navarro-Mateu et al., 2020). These findings highlight the importance of these variables for academic performance since those who had great academic self-efficacy also presented more study and cognitive tools that helped organize themselves better (Delgado et al., 2019).

Some research indicated that there were no differences between women and men in academic self-efficacy (Rivera-Heredia et al., 2016; Hernández-Jácquer, 2018); however, Narváez-Olmedo et al. (2018) concluded that it is men who showed the highest perception of academic self-efficacy.

Academic self-efficacy is a variable to be considered in the university context, as it indicates students' future goals according

to their abilities, such as achievement motivation, access to scholarships, academic performance, or permanence in higher education (Borzone, 2017). But, in this time of confinement, when we have quickly moved from face-to-face teaching to remote emergency teaching (Abreu, 2020), it was important to analyze whether this improvised change could affect the expectations of perceived self-efficacy of university students to achieve academic success, since students were not prepared.

There is little research on the impact of the pandemic and its influence on levels of anxiety in university students, and even less related to expectations of academic self-efficacy. For this reason, the objective of this research is to analyze the relationship between perceived self-efficacy and trait anxiety (TA) and SA, during the first moments of COVID-19, since it was an exceptional situation to learn how university students responded to critical situations (related to SA). In addition, the situation of uncertainty and ignorance about the disease was high, generating a great concern in the Spanish population and, more specifically, in university students, given the challenges they faced with the closure of the university.

There were two hypotheses: (1) there is an inversely proportional relationship between academic self-perception and TA and SA; and (2) the students are more sensitive to this situation if they manifest higher TA and also if they or their relatives and friends have suffered from COVID-19.

MATERIALS AND METHODS

The design used in this research was a retrospective or *ex post facto* study (Sharma, 2019) with a cross-sectional design to collect data.

Participants

The research was carried out in the Melilla Campus at the University of Granada (UGR) (Spain). For the selection of the participating sample, a non-probability sampling was used, using the virtual snowball technique (Baltar and Gorjup, 2012).

The selected sample consisted of 427 university students with an average age of 21.30 years (SD = 3.27), ranging 20 years, minimum age is 18 and maximum age is 41. Eighty-four of the participants were men (19.7%), and 342 were women (80.1%). This percentage is a reflection of the feminization of the degrees in nursing and education sciences. A total of 52.3% (n = 227) of participants were enrolled in the Faculty of Education and Sport Sciences, 37.6% (n = 160) were enrolled in the Faculty of Nursing, 3.3% (n = 14) belonged to the Faculty of Social Sciences, and 5.9% (n = 25) studied master's degrees.

In addition, 1.6% (n = 7) of the students had suffered/were suffering from COVID-19 compared to 98.4% (n = 420) who answered no. In addition, 23.2% (n = 99) students affirmed that a friend or a relative had suffered from COVID-19, and of these, 10.8% (n = 46) died of it.

Measures and Procedure

The questionnaires were administered online in March. This was the time of greatest uncertainty and when the state of alarm was declared due to COVID-19. For this purpose, the delegates of the courses from the faculties of the University of Granada at the Melilla Campus (Spain) were contacted *via* e-mail. The questionnaires were uploaded to the Google Form application (free access) with instructions on how to complete it. Furthermore, students were asked to explicitly consent to participate in this experience willingly and anonymously, following the indications given by the Committee on Publication Ethics (COPE).

The questionnaire, https://forms.gle/yP9vgWmAs7e8b6WE7, consisted of three sections:

1. The sociodemographic data section collected information on age, ongoing studies, if he/she suffered/had suffered from COVID-19, and if any relative or friend suffered/had suffered from COVID-19 and if they had died of this cause.
2. The "Adaptation of the Specific Perceived Self-Efficacy Scale in Confinement Situations by COVID-19 (ASPS-COVID-19)" Scale was based on the "Academic Situations Specific Perceived Self-Efficacy Scale" by García-Fernández et al. (2010), consisting of 10 items, with a 4-point Likert-type response format that ranged from 1 (never) to 4 (always). The minimum score was 10 and the maximum was 40, with a reliability of 0.92. The objective was to measure the expectations of self-efficacy in specific situations in the educational context in university students at the time of isolation due to the pandemic. Therefore, the text clarification "during the confinement due to COVID-19" was added to the items of the original scale, keeping the original answer format, so the higher the score, the greater the perceived academic self-efficacy.
3. The "Adaptation of the Trait Anxiety/State Anxiety Scale in Confinement Situations by COVID-19 (ATA/SA-COVID-19)" Scale was based on the Spanish adaptation of the "State-Trait Anxiety Inventory (STAI)" by Spielberger et al. (1982). The scale was composed of 20 items for the Trait Anxiety Subscale (TA) and 20 for the State Anxiety Subscale (SA). The response formats ranged from 0 (hardly ever) to 3 (almost always). The internal consistency indices were 0.96 and 0.88, respectively. The ATA/SA-COVID-19 was made up of 54 items, 28 for TA and 26 for SA. The answer had a 4-point Likert-scale format that ranged from 1 (not at all) to 4 (very often). The minimum score was 28 for TA and 26 for SA. Items were added and repeated in both scales to measure the influence of the pandemic on the emotional and motivational factors that might affect academic goals, such as Anger, Outrage, Boredom, Distraction, Discouragement, and Despondency. Positive items scored inversely (TA: 2, 5, 7, 10, and 15; SA: 1, 2, 5, 8, 10, 11, 15, 16, 20, and 27), so that the higher the score, the higher the anxiety level.

Data Analysis

Statistical software SPSS 25.0 was used for conducting descriptive analysis of the data, ANOVA test, reliability statistics, and multivariate analysis. Statistical significance was set at $p < 0.05$. Effect size was reported with Cohen's.

RESULTS

Table 1 showed the reliability and descriptive analyses of the total score of the different scales used. As it can be observed, the reliability was very high in the three instruments used. In relation to the TA Subscale and in the SA Subscale of the ATA/SA-COVID-19, items 1, 5, 6, 13, and 18 and items 19, 21, 22, and 24 were removed, respectively, as the corrected item–total correlation was under 0.30. The two subscales were composed of 24 items, with a very high inner consistency index, which was measured with the Cronbach's alpha.

In relation to the first hypothesis, the relationship between ASPS-COVID19 and the ATA/SA-COVID-19 subscales was analyzed. The Pearson's correlation coefficients indicated moderate and significant ($p < 0.001$) relationships between the scales (**Table 2**), thus increasing anxiety-reduced perceived academic self-efficacy.

Furthermore, in relation to the ASPS-COVID-19 scale, students were classified into three groups: low perception of academic self-efficacy (means below the 20th percentile, $\bar{x} \leq 16$), moderate level of self-efficacy (means between the 21st percentile to the 79th percentile, $\bar{x} \geq 17.00$ to $\bar{x} \leq 26.00$), and high level of academic self-efficacy ($\bar{x} \geq 27.00$). The data showed that the students with the lowest levels of self-efficacy were 99 (23.2%), of which 42 (42.4%) presented very high levels of both TA and SA; 39 women and three men presented the highest level of SA. In addition, one student had suffered from the disease, 19 had a relative who had suffered from it, of whom five had died from COVID-19.

The inferential analysis based on the sex variable showed significant differences. Women showed lower levels of self-efficacy than men ($\bar{x}_{\text{MEN}} = 14.73$; $\bar{x}_{\text{WOMEN}} = 12.91$; $t = 3{,}295$; $p < 0.005$;$_{\text{dCOHEN}} = 0.717$; $r_{\text{SIZEEFFECT}} = 0.337$). The size effect was large. Regarding whether any relative had died, data indicated that the students who had lost a relative scored lower in the perception of academic self-efficacy ($x_{\text{YES DECEASED}} = 11.69$; $x_{\text{NODECEASED}} = 13.52$; $t = -2.243$; $p < 0.05$; $d_{\text{COHEN}} = -0.708$; $r_{\text{SIZEEFFECT}} = 0.334$). The size effect was large.

Multivariate inferential analyses, using SA and TA as covariates and their influence on perceived self-efficacy, showed significant differences ($F_{2,426} = 7.57$, $p < 0.000$; ηp2parcial = 0.035), which indicated that the higher the levels of TA and SA, the worse the perception of self-efficacy in academic performance.

Regarding the second hypothesis, firstly, in the TA and SA subscales, students were classified into three groups in such a way that the first group, with a low level of anxiety, was the one that obtained average scores below the 20th percentile. The group with moderate anxiety level ranged from the 21st to the 79th percentile. Last, the third group, with high anxiety levels, obtained means over the 80th percentile. These were the criteria for the three scales. In **Table 3**, students are presented according to their level of TA and SA.

In addition, the students who presented high scores on the TA Scale were selected (PC80 $\bar{x} \geq 76$). They were a total of 89 (21.07% of the total sample). In this group, nine were men (10.1%) and 80 were women (89.9%), only two university students (one man and one woman) had COVID19 (2.2%). Furthermore, 39 students had a relative or a friend who had suffered from the disease (43.8%), of whom 11 died (12.4%). Of the 89 university students, 79 (88.8%) also showed high levels of SA (PC80 $\bar{x} \geq 77$) and 10 (14.6%) moderate levels. Sixty-seven were women (83.8%) and nine were men (16.2%); two of them had suffered from the disease. In relation to whether a relative/friend suffered/had suffered from COVID-19, 35 answered yes and 12 reported they died of the virus.

In the analyses of the students ($n = 427$), TA and SA showed that the SA was high in this pandemic time during the confinement, the analyzed data showed significant differences, increasing the SA in this pandemic time (TA = 63.74; SA = 66.55; $t = -7.212$; $p < 0.005$; $d_{\text{COHEN}} = -0.206$; $r_{\text{SIZEEFFECT}} = -0.102$); the size effect was medium. Although there were no significant differences, the SA was higher in the students who had a sick

TABLE 1 | Descriptive statistics for the scales.

Scales		*N*	Mean	Standard deviation	Minimum	Maximum	Skewness	α
ASPS-COVID19 10 items	427	21.11	6.17	10.00	37.00	−0.019	0.914	
ATA/SA-COVID-19	Trait Anxiety (TA) 28 items	427	54.84	11.04	29.00	80.00	−0.080	0.880
	State Anxiety (SA) 22 items	427	74.74	11.37	49.00	102.00	−0.008	0.863

N, participants; α, Cronbach's alpha. ASPS-COVID-19, Adaptation of the Specific Perceived Self-Efficacy Scale in Confinement Situations by COVID-19; ATA/SA-COVID-19, Adaptation of the Trait Anxiety/State Anxiety Scale in Confinement Situations by COVID-19.

TABLE 2 | Correlation between scales.

Scales		ASPS-COVID-19	ATA-COVID-19	ASA-COVID-19
ASPS-COVID19		**1**	**−0.471**	**−0.441**
ATA/SA-COVID-19	Adaptation of Trait Anxiety (ATA-COVID-19)	−0.471	1	0.774
	Adaptation of State Anxiety (ASA-COVID-19)	−0.441	0.774	1

ASPS-COVID-19, Adaptation of the Specific Perceived Self-Efficacy Scale in Confinement Situations by COVID-19; ATA/SA-COVID-19, Adaptation of the Trait Anxiety/State Anxiety Scale in Confinement Situations by COVID-19.

TABLE 3 | Description of the students according to their level of TA and SA (N = 427).

		Trait Anxiety (TA)			Total
		Low levels (PC < 20) $\bar{x} \leq 51.00$	**Medium levels PC < 21 a PC > 79 $\bar{x} \geq 52$; $\bar{x} \leq 75.00$**	**High levels PC > 80 $\bar{x} \geq 76.00$**	
State anxiety (SA)	Low levels (PC < 20) $\bar{x} \leq 57.00$	N = 80	N = 26	N = 3	N = 109
		18.7%	6.1%	0.7%	25.5%
	Medium levels PC < 21 a PC > 79 $\bar{x} \geq 58.00$; $\bar{x} \leq 76.00$	N = 29	N = 144	N = 33	N = 109
		6.8%	33.7%	7.7%	48.2%
	High levels PC > 80 $\bar{x} \geq 77.00$	N = 0	N = 22	N = 90	N = 109
		0.0%	5.2%	21.1%	26.2%
Total	109	192	126	427	
	25.5%	45.0%	29.5%	100%	

PC, percentile; N, participants; x̄, mean.

relative who died of COVID-19 (TA = 63.06; SA = 67.46; $t = -1.101$; $p > 0.05$). The results of the students with high levels of SA (n = 109) indicated that a 100% felt worried and nervous, 90.8% felt distressed, and 80% felt helpless in the situation.

Among the characteristics presented by the students with high levels of TA (n = 126) and in relation to their teaching-learning process, the data indicated that they were unfocused (91.1%), unmotivated (98.8%), and discouraged (100%) in the situation they were experiencing (95%). In relation to how they experienced the confinement, 91% felt angry, 85% outraged, and 80% felt unhappy about the pandemic.

DISCUSSION AND CONCLUSION

The objective of this research is to analyze the relationship between perceived self-efficacy and TA and SA during the first moments of COVID-19. With this objective, the "Academic Situations Specific Perceived Self-Efficacy Scale" and "State-Trait Anxiety Inventory (STAI)" questionnaires were adapted.

The reliability found in the ASPS-COVID-19 was similar to that obtained by García-Fernández et al. (2010). In the same way, the ATA/SA-COVID-19 Subscales obtained high internal consistency indices similar to Fonseca-Pedrero et al. (2012).

Regarding the first hypothesis, the data showed that there was an inversely proportional relationship between the perception of academic self-efficacy and anxiety, both TA and SA, results in line with the research of Gutiérrez-García and Landeros-Velázquez (2018), Navarro-Mateu et al. (2020), and Colom (2012). One explanation might be that anxiety is related to both cognitive and motivational and emotional processes. In this way, negative emotions such as tension about how students experienced the pandemic and a high level of concern could decrease the levels of achievement and self-efficacy (De la Fuente et al., 2019). But also, university students with high levels of anxiety showed high scores in demotivation, discouragement, and boredom, results in line with the research of Vancouver (2018). These motivational characteristics could negatively affect the expectations of self-efficacy that, together with the demands of the university context, could interfere with their academic aspirations (Ahmadi, 2020). In addition, the psychological pressure of the confinement (Xiao, 2020) was joined to the academic demands, workload, and online evaluations that could negatively affect the perception of academic self-efficacy (Navarro-Mateu et al., 2020), generating higher levels of anxiety in university students (Huarcaya-Victoria, 2020). In addition, not attending classes due to the closure of universities was a factor of concern and anxiety (Kelly, 2020), since the work methodology changed (Abreu, 2020) when the students were not prepared.

As for the second hypothesis, there was a directly proportional relationship between TA and SA. The students with the highest TA also increased their level of SA during COVID-19. This might be due to the fact that the pandemic generated a stressful situation causing highly negative emotions, mainly in students who had someone close diagnosed with COVID-19 (Cao et al., 2020) and those who reported the death of a relative or a friend (Mohammed et al., 2015; Ho et al., 2020). Thus, the data showed that students with high levels of SA indicated feeling distressed and helpless in this situation, as reported by the American College Health Association (2019).

Regarding the analyses of the sex variable, men showed a better perception of self-efficacy, data consistent with those found by Narváez-Olmedo et al. (2018). On the other hand, women presented higher levels of anxiety, as reflected by Gutiérrez-García and Landeros-Velázquez (2018), Cao et al. (2020), and Taylor et al. (2020). Their SA increased in stressful situations, such as the death of a relative (Ho et al., 2020), which directly affected the perception of self-efficacy; this result coincided with Gutiérrez-García and Landeros-Velázquez (2018) and De la Fuente et al. (2019) who came to the conclusion of the relationship between self-efficacy and emotionality. Gender differences in academic self-efficacy could be associated with socialization processes and the perpetuation of gender stereotypes in young university students, learned within a sociocultural context.

Some limitations must be acknowledged: first, the type of sampling, but given the situation of confinement, it was the only possibility to obtain data. These data were collected at the

beginning of the pandemic. The cross-sectional methodology of this study was necessary and mandatory, but it has been compared with other investigations. For future studies, stratified non-probability sampling will be used and the number of participants will be increased. Secondly, SA and TA and their relationship with the perception of academic self-efficacy have been analyzed, but it is still necessary to include other complementary instruments, such as effects of changes in learning through academic performance (grades), resilience, self-concept, and cognitive-motivational factors that might affect the variables studied. It will be necessary to continue working on the adaptation of the instrument used as well. Third, we did not analyze the effect of the methodological change and how it affects TA and SA and the perception of academic self-efficacy in the e-learning model, so it should be studied in subsequent investigations.

To conclude, students who show a higher level of anxiety (TA and SA) express more negative emotions and also perceive themselves with less academic self-efficacy. Therefore, a stressful situation (pandemic and confinement) together with a critical event (illness and death of a relative/friend due to COVID-19) increases anxiety levels and influences the perception of academic self-efficacy.

Thus, students in exceptional situations increase their levels of anxiety and reduce their perception of academic self-efficacy that can put their permanence in higher education at risk. Therefore, it is necessary to follow up on university students after confinement in order to explore the causes of anxiety and the influence that COVID-19 had on their academic performance and on their permanence in university.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

IA-A contributed to the research conception and design, data analysis and interpretation, statistical analysis, and critical revision of the manuscript for important intellectual content. GR-R contributed to obtaining information, reading the manuscript, and critical revision of the manuscript for important intellectual content. JG-V contributed to obtaining information, reading the manuscript, and critical revision of the manuscript for important intellectual content. ÁM-E contributed to the research conception and design, obtaining information, data interpretation, reading the manuscript, and critical revision of the manuscript for important intellectual content. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2020.570017/full#supplementary-material

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SYSTEMATIC REVIEW
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Systematic Review of the Literature About the Effects of the COVID-19 Pandemic on the Lives of School Children

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Background: The year 2020 has been marked by the emergence of coronavirus disease 2019 (COVID-19). This virus has reached many countries and has paralyzed the lives of many people who have been forced to stay at home in confinement. There have been many studies that have sought to analyze the impact of this pandemic from different perspectives; however, this study will pay attention to how it has affected and how it may affect children between 0 and 12 years in the future after the closure of schools for months.

Objective: The objective of this article is to learn about the research carried out on the child population in times of confinement, especially those dealing with the psychological and motor aspects of minors.

Methods: To carry out this systematic review, the PRISMA statement has been followed to achieve an adequate and organized structure of the manuscript. The bibliography has been searched in the Web of Science (WOS), Scopus, and Dialnet databases, using as keywords: "COVID-19" and "Children." The criteria that were established for the selection of the articles were (1) articles focusing on an age of up to 12 years, (2) papers relating COVID-19 to children, and (3) studies analyzing the psychological and motor characteristics of children during confinement.

Results: A total of nine manuscripts related to the psychological and motor factors in children under 12 have been found. The table presenting the results includes the authors, title, place of publication, and key ideas of the selected manuscripts.

Conclusion: After concluding the systematic review, it has been detected that there are few studies that have focused their attention on the psychological, motor, or academic problems that can occur to minors after a situation of these characteristics. Similarly, a small number of studies have been found that promote actions at the family and school level to reverse this situation when life returns to normal. These results may be useful for future studies that seek to expand the information according to the evolution of the pandemic.

Keywords: children, COVID-19, coronavirus, physical activity, psychology

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INTRODUCTION

When news of an epidemic began to spread in a Chinese city in early 2020, no one anticipated the scope of the epidemic for the entire world in a very short period. From Wuhan (China) to New York (USA) through Africa, South America, Asia, and Europe, the new coronavirus, coronavirus disease 2019 (COVID-19) or severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has paralyzed, to a greater or lesser extent, the life in many countries, causing thousands of deaths and about 6 million infections. For these reasons, the scientific community is on the alert by conducting studies on the virus, the disease it produces, the situation it creates, and the population it attacks, from different perspectives, including systematic reviews of the literature, such as the one presented in this paper.

However, researchers on this topic are not only biologists or physicians. It is worth noting the contribution of Maestre Maestre (2020), President of the Society for Latin Studies, in an article on the virus that has caused the pandemic, in which, playing with different related terms, he explains that the neutral noun "virus" means "poison" in Latin, so most current research is trying to find a medicine that will kill the virus. Likewise, the Greek term φάρμακον (in Latin pharmacum) also means poison. The relationship between the two terms is that pharmacies are looking for poisons that will kill the "poisons" that undermine people's health or their desire to be safe. Remember the symbol of the pharmacies, the "Bowl of Hygieia" with the snake that pours a "poison" into it that stops being a poison to become an antidote. The name "coronavirus" is given to it because, through the microscope, the "virus-poison" is shaped like a "crown" that makes it king of poisons.

However, in addition to scientists who study the pandemic, biologists, doctors, and humanists, educators are obliged to care for the psychological and emotional health, as well as cultivate the minds, of children. The consequences of the containment measures of COVID-19 are being detrimental to the mental health of people around the world. It is logical that the most vulnerable are children who do not understand what is happening and who, along with the concern and frustration of their elders, may present risk factors, such as anxiety and affective and post-traumatic stress disorders (Giallonardo et al., 2020). However, not only minors are affected. According to Roy et al. (2020), more than 80% of people over 18 have shown the need for attention to their mental health as a result of the anxiety and stress experienced during the pandemic. Forte et al. (2020) agree with this idea, stating that the pandemic has caused stress, psychological discomfort, sleep disorders, and instability, among others, in a large part of the population.

In this sense, many questionnaires have been applied to obtain information in the educational context or related to it from research groups at different universities, including the one from the IDIBAPS research group at the Hospital Universitario de Barcelona, concerning behaviors to reduce emotional distress during the pandemic and confinement by COVID-19, https://enquesta.clinic.cat/index.php/268395?lang=es; Universidad de las Palmas de Gran Canaria on family relationships during confinement: Study of the effect of COVID-19 in the family context, https://forms.gle/2xpmqRtQ8mtBMAz77; Universidad de Oviedo, as a longitudinal study on how isolation and the practice of physical activity (PA) during confinement is affecting to offer effective strategies that it called "pills": EDAFIDES Questionnaire COVID-19, https://docs.google.com/forms/d/e/1FAIpQLSfyID6X7YgUejwXNv2YyOQ1YU2LrFsPkkvHzux_TD_BjPIGNw/viewform?usp=sf_link; Euskal Herriko Unibertsitatea, to find out about the situation of university students in confinement and to propose improvements: https://forms.gle/jDkFgW7xeKfSFNHB6; Universidad da Coruña y Universidad de Jaén, on the activities of children in Spanish homes in times of confinement. This last questionnaire was applied in Spain and in South America: https://docs.google.com/forms/d/e/1FAIpQLSeyBBkMEmPxj-AoPQG98QorsaLyNex9wlI2FJ2Ku2q8nbsdNQ/viewform.

Based on the above-mentioned questionnaires, there is a concern to analyze how confinement has affected children under 12 at the motor and psychological levels. This literature review is carried out and explained in detail in the procedure and search strategy of the methodology. The impact of the pandemic is such that many national and international journals are offering special issues on COVID-19, including Frontiers, which, being digital, contains 229 articles signed by many authors from various countries, which look at the subject from different perspectives: there are eight that refer to age and especially to children in some way, including: who cares about the elderly (Fischer et al., 2020), physical inactivity (Ricci et al., 2020), age distribution (Cortis, 2020), and newborns (Ovali, 2020), but none discusses parents' views on the period of confinement from the psychological, educational, academic, physical, and emotional points of view of their children. Neither do they inquire into the opinion of the children themselves, understanding by these those who are in infant and primary education, that is, up to the age of 12.

Education must seek to provide the child with a comprehensive education, trying to help his or her physical, emotional, intellectual, family, social, and moral development. Active methods are crucial for early childhood education, and teachers are needed to apply them in schools (Salvador, 2008), now in the homes of their students, which they access through the Internet. The role of parents is also to educate, but from different perspectives, complementing those of teachers in the acquisition of children's learning. For these reasons, many families say that they do not know how to undertake these activities with their children for so long.

Likewise, the lack of other family members, such as grandparents, who had been playing a role in accompanying, especially with children in preschool, complicates the state of confinement and the lack of school attendance that is taking place, initially planned for 6 months in a row. The study by Clemente-González (2016) of the University of Murcia highlights the relevance of grandparent–grandchild relationships and the role of the former in the social and emotional development of the child, which gives great significance to their grandparents for the appreciation observed in them, recognizing their importance in the family structure. At this point, it is also necessary to point out the lack of relationships between equals, which is so important for the correct emotional development of children.

Another important aspect that has been affected by the coronavirus pandemic is the practice of PA. Many schoolchildren practice physical exercise based solely on the subject of Physical Education. This subject is not only based on motor skills but is a practice that affects schoolchildren in a global way, influences many aspects of their daily lives, and helps teachers to better understand students in their different dimensions (Founaud and González-Audicana, 2020). Lack of PA is associated with obesity, as indicated by different studies that relate the regular practice of physical exercise with the reduction of health problems (Castañeda-Vázquez et al., 2020).

The opinion article written by the Spanish secondary school teacher, Fandino-Pérez (2020), is significant in which he reflects on the virtuality of education and his position regarding personalized education, so demanded in times of normality, where teachers and students know each other, interact, and socialize, precisely the attitude that has taken away the virus. Fandino-Pérez says that the pandemic has put us in front of the mirror to see a distorted and absurd image of the work of teachers as producers of programming and good results, which turns them and their students into a kind of machine. We have forgotten the main thing: to be human beings capable of creating a better world and of overcoming ignorance, fear, and demagogy.

As a background to this study, we refer to March 11, 2020 when the World Health Organization (World Health Organization, 2020a) declared this disease produced by the coronavirus (COVID-19) to be a pandemic. It was first reported in Wuhan (China) on December 31, 2019. According to World Health Organization (2009), the global public health community recognized the need for standardized research and data collection after the 2009 flu epidemics, so the WHO Expert Working Group on Special Research and Studies has developed several standard protocols for pandemic flu. This has led World Health Organization (2019a, 2020b) to develop similar protocols for the Middle East respiratory syndrome coronavirus (MERS-CoV) and, with the support of expert advisors, has adapted the protocols for influenza and MERS-CoV to help better understand the clinical, epidemiological, and virological characteristics of COVID-19.

Some months have passed, and most of the inhabitants of planet Earth, more or less surprised, have been confined to their homes for about 60 days, where they have carried out their work online and have had to attend to their younger children, also confined without attending school and without being able to go out into the street or use the recreational facilities that some residential areas have.

When we find ourselves at the moment of reincorporation into the daily life known before the appearance of the pandemic (May 2020), other illnesses arise as a consequence of the involuntary confinement to which the population has been subjected; this is the cave syndrome or agoraphobia (fear of open spaces), and it is possible that with the passage of time, other psychological and affective disorders will arise in the adults who will be those who have suffered this confinement and this disaster as children.

The disease mainly attacks people over 70 years old and only 0.3% of children in countries where there have been more deaths (for example, Spain). According to the Instituto de Salud Carlos, this may be the reason why medical research does not deal with children, but these subjects have special psychological, academic, and emotional characteristics at a stage of their lives when they are in full development, so from the educational point of view, it is necessary to find out how children have developed in their homes, what their parents think, and what future expectations experts, teachers, and psychologists have for them.

For all these reasons, the aim of this work is to find out about the research carried out on the child population in times of confinement, especially those that deal with the psychological and motor aspects of minors.

Considering this objective and following the Population, Intervention, Comparison, and Outcome (PICO) strategy, the following research question arises: what do the studies already published determine about how confinement has affected children under the age of 12 on a psychological and motor level?

METHODOLOGY

For the elaboration of this systematic review, we have followed the items to publish systematic reviews and meta-analyses of the PRISMA statement (Sotos-Prieto et al., 2014; Hutton et al., 2015), in order to achieve an adequate and organized structure of the manuscript. The guidelines of Cochrane Training (Higgins and Green, 2011) have also been used.

Procedure and Search Strategy

The literature review took place during the last weeks of May 2020 and focused mainly on the Web of Science (WOS) database, using Scopus and Dialnet as support. The topic considered for the selection of articles was the one related to the global pandemic caused by COVID-19 and how it has affected psychologically and motorically children up to 12 years old. The following keywords were used: "COVID-19" and "children" and the Boolean operator "and." After this first search and taking into account only the works published in 2020 (since that is when the pandemic occurred), 837 scientific documents were obtained. By restricting the search to only journal articles, the documents were reduced to 576 articles, after which the language filter was applied, selecting only those papers published in English and Spanish, leaving a total of 537. Since the pandemic started in China, the initial search was also done in that language, not finding any related articles. The articles signed by researchers of Chinese nationality are written in English. Finally, the following areas of research were chosen: "Psychology," "Sociology," and "Education Educational Research," finally limiting the search to 48 scientific articles, which make up the sample of this study.

Inclusion and Exclusion Criteria

The criteria that were established for the selection of the articles were (1) articles focusing on an age of up to 12 years, (2) papers relating COVID-19 to children, and (3) studies analyzing the psychological and motor characteristics of children during confinement.

In order to apply these criteria, a first preliminary reading of the title and summary of each article was carried out, which

made it possible to rule out papers that did not meet the above-mentioned criteria. A more exhaustive reading of the selected articles was then carried out, leaving a final sample of nine scientific papers (**Figure 1**).

Article Coding

To extract the data from the articles, the following coding process was followed: (1) author/authors and year of publication, (2) title of the research, (3) place/country of publication, and (4) key ideas of the research.

The research included in this systematic review was coded by four of the authors, in order to check the reliability of the coding and the degree of agreement among the researchers in relation to the selection and extraction of the data (González-Valero et al., 2019). The degree of agreement on the rating of the articles was 93%. This was obtained by dividing the number of coincidences by the total number of categories defined for each study and multiplying it by 100.

In order to establish the methodological quality of the present study, reliability was determined according to the detection and selection of the Fleiss' Kappa (Fk) statistical index for more than two evaluators (Fleiss, 1971). A value of Fk = 0.780 was obtained for data extraction and selection, which indicates that there is substantial agreement (0.61–0.80).

Table 1 presents the main results of different studies following the codification indicated in the previous section: (1) author/authors and year of publication, (2) title of the research, (3) place/country of publication, and (4) key ideas of the research.

DISCUSSION

Of the nine articles analyzed because they met the characteristics of the search, three have been published in *The Lancet*, which began as an independent international weekly medical journal, founded in 1823 by Thomas Wakley. Since its first issue, it has

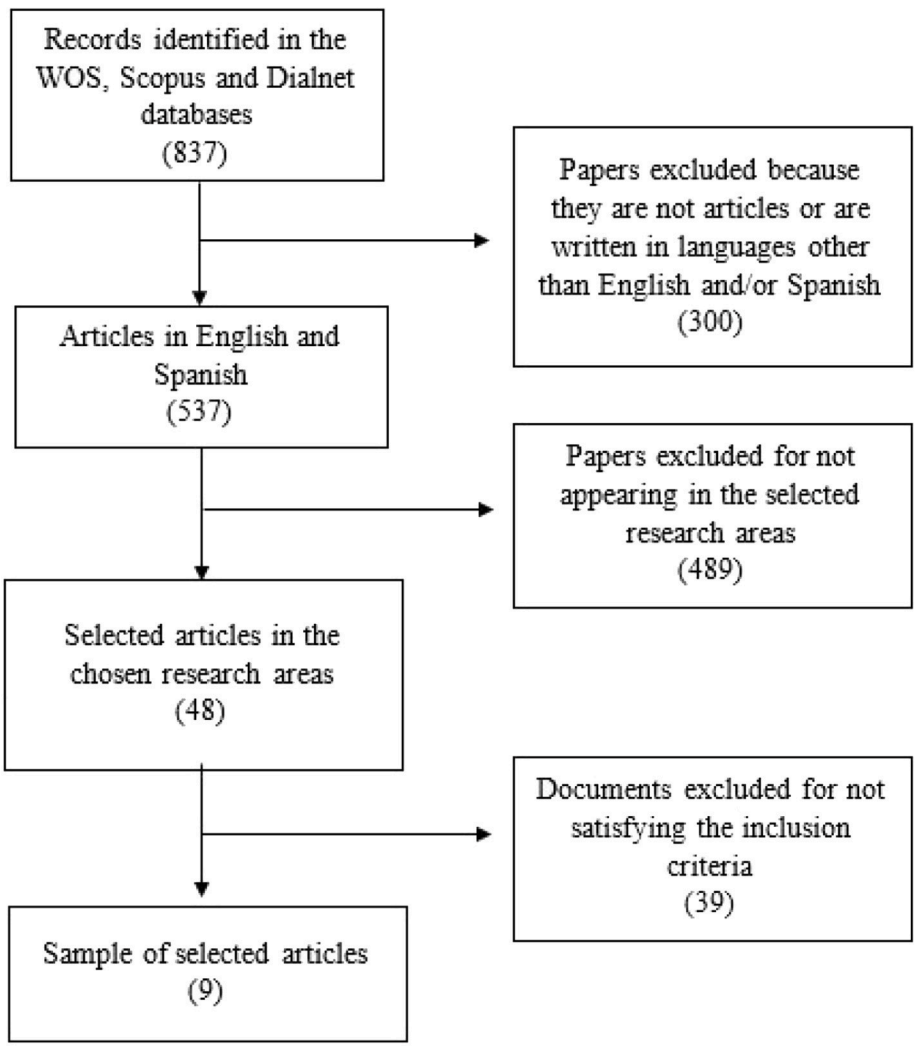

FIGURE 1 | PRISMA flowchart.

TABLE 1 | Basis of the study.

Authors and year	Title	Country	Key ideas
Szabo et al. (2020)	From helpless to hero: promoting values-based behavior and positive family interaction in the midst of COVID-19	USA	- Importance of the role of parents in the confinement of their children. - It is necessary for parents to establish schedules and routines to achieve psychological stability for their children. - Tips are proposed to make confinement easier for children
Dalton et al. (2020)	Protecting the psychological health of children through effective communication about COVID-19	UK	- Psychological consequences that confinement can have on children. - Children are exposed to large amounts of information and may not know how to handle it. Parents have to explain the situation to them, taking into account their age, making them see that they are not to blame for the situation. - Children may show distress, guilt, feel threatened, worry…. - They miss their other caregivers (e.g., grandparents)
Yarimkaya and Esentürk (2020)	Promoting physical activity for children with autism spectrum disorders during coronavirus outbreak: benefits, strategies, and examples	Turkey	- It focuses on children with autism spectrum disorder (ASD). - It deals with the importance of PA during confinement. - It proposes exercises that these children with ASD can do during the time they are locked up in the house
Liu et al. (2020)	Mental health considerations for children quarantined because of COVID-19	China	- It focuses on children who are separated from their families or caregivers because one or the other is infected with coronavirus. - These children are at risk for acute stress, adjustment disorder, and grief. - Children who are isolated because they are infected with the coronavirus may suffer from post-traumatic stress. - Children who have lost their parents to this infection may commit suicide as adults as a result. - As for "normal" home confinement with parents, they mention that it can cause stress in children, although being with their parents can relieve it
Ricci et al. (2020)	Recommendations for physical inactivity and sedentary behavior during the coronavirus disease (COVID-19) pandemic	Italy	- It focuses on the inactivity and sedentariness that the coronavirus has brought to the world population and its consequences on the health of individuals. - It presents PA recommendations for the entire population, also specifically mentioning exercise for children
Guan et al. (2020)	Promoting healthy movement behaviors among children during the COVID-19 pandemic	China	- Reminder of the worldwide recommendations on daily PA time in children. - Child sedentarism as an effect of confinement. - Increased use of digital technologies. - Recommendations to parents and caregivers for the promotion of daily healthy behaviors
Zhang et al. (2020)	Acute stress, behavioral symptoms and mood states among school-age children with attention-deficit/hyperactive disorder during the COVID-19 outbreak	China	- Worsening behavior in children with attention-deficit/hyperactive disorder during confinement. - Stress levels experienced by family members and children with this disorder
Álvarez-Zarzuelo (2020)	El confinamiento de niñas y niños En España en 2020 por la Crisis del COVID-19: Propuestas desde la Educación Social Escolar para la vuelta al centro escolar	Spain	- Personal opinion article. Social educator concerned with how confinement will affect children psychologically. - Digitally illiterate or financially unsound families will create an academic gap among children. - Compilation of 12 needs of confined minors and responses at the socio-educational level to address them on their return to the classroom
Gómez-Gerdel (2020)	El cerebro pleno del niño/a: la labor de un/a maestro/a de educación inclusiva con las familias en tiempos de confinamiento. Una reflexión educativa	Spain	- Crisis in the Spanish educational system originated by the COVID-19 pandemic, consequence: virtual education. - Benefits of confinement: possibility for minors to acquire greater autonomy in daily household tasks and improvement in family relations by living together with parents and children for longer periods of time. - Inclusive education in confinement and its difficulty in alleviating inequalities. - Self-knowledge and understanding of emotions and actions. - Promotion of correct coexistence with children in confinement and techniques for the integration of the upper and lower brain

strived to make science widely available so that medicine can serve, transform society, and positively impact people's lives. It has evolved into a family of journals including *The Lancet Child & Adolescent Health*, in which one of the three articles cited appears. These three articles, and most of those analyzed, relate to the classical medicine that should serve society to help improve life.

Most of the references in this article (84.22%) are from the year 2020, a sign of the interest in the subject and the dedication of scientists and teachers. Only three are earlier, the one by Hutton et al. (2015) that deals with a more technical content, the extension of PRISMA for network meta-analysis, and the ones by Salvador (2008) and Clemente-González (2016) that highlight the role of grandparents in children's lives.

Of the two articles by Spanish teachers, the one by Álvarez-Zarzuelo (2020) is a personal opinion of a social educator who is ahead of other research. It only provides the experts' ideas on the possible repercussions of confinement. For his part, Gómez-Gerdel (2020) writes an opinion article that, exceptionally, is being published by the International Journal of Education for Social Justice in its special issue 9(e) on "Consequences of the Closure of Schools by COVID-19 on Educational Inequalities." The author, from the perspective of the departments of Educational Guidance that deal with inclusive education, raises the chaos that it has meant for the Spanish Educational System to apply teaching only on line, which means for the most vulnerable families: difficulties in accessing technologies and delays in education. On the other hand, it raises what could be a return to the family whose members had been living together for a long time, something absolutely necessary for the correct development of the minors who spend too much time away from home.

The teaching–learning system, which should seek the comprehensive training of the child, in which parents and teachers should participate, has been drastically modified, trying not to abandon the active methods used in schools (Salvador, 2008), with the difficulties that this entails for families, which in many cases have no training in this area.

Of the three articles by Chinese authors, Liu et al. (2020) analyze the situation of children whose parents have been infected with the virus or have died; Zhang et al. (2020) observe the behavior of children with attention-deficit/hyperactive disorder (ADHD) during this period; and finally, Guan et al. (2020) deal with the practice of childhood PA during confinement. Therefore, only one of them studies a type of activity in this period, the one dealing with PA coinciding with what is written by the Italians Ricci et al. (2020); in the same line, we find the Turks Yarimkaya and Esentürk (2020) who deal with the importance of PA in confinement for children with autism spectrum disorder (ASD). It is important to remember that World Health Organization (2010, 2019b) recommends a minimum of 1 h/day of moderate–vigorous PA in children, but that only one-third of children exceed these recommendations (Salas-Sánchez et al., 2020).

The American and British authors analyze the role of parents in the confinement of their children and provide some advice on this subject. They also look at the future psychological problems that may arise as a result of over-information, change of routines, and manifestation of feelings of distress and guilt, as well as the need to see peers and other carers (teachers, grandparents). They coincide with Clemente-González (2016) project based on the grandparent–grandchild relationship and the promotion of identity, which seemed to be a premonition of what would happen with the arrival of the COVID-19 pandemic that would force the disappearance of these relationships for a long time.

It is important to note that, according to the review carried out, there are authors who analyze the pandemic from different perspectives with which we agree: cultural aspects (Maestre Maestre, 2020); actions of biologists and doctors, more distant from our intentions; humanists (Fandino-Pérez, 2020), and especially for this study, of educators who are aware that the essence of being in the classroom and the immediate feedback that students offer in this situation has been lost. To this must be added the role of the WHO, overwhelmed by the health events that have occurred so quickly, as described in these lines.

We believe that the application of many questionnaires during the confinement and currently post-COVID-19 pandemic has saturated the patience of the respondents, although most have helped scientists and educators to obtain information that will facilitate a smooth exit from this disaster.

CONCLUSIONS

The above leads us to the general conclusion that there are very few studies on how confinement has affected children under 12 years old psychologically and motorly. These articles agree on the consequences that confinement can have on minors and on the importance of psychological support from the family, and the establishment of routines can be effective. The manuscripts that deal with PA remind us of the importance of it and indicate that the rates of sedentarism have increased during these months.

It is necessary to insist on the search for and analysis of other activities, as well as the behavior of parents and children in these circumstances, in order to prevent possible psychological and academic problems and because if the online teaching situation is prolonged, it is very important to know how to act from the educational and family environment.

The main limitation the authors have faced has been the small number of scientific articles related to the area of study. This scarcity of published works makes it necessary to continue researching this. This is the reason why our study can serve as a starting point or theoretical foundation for further studies.

AUTHOR CONTRIBUTIONS

JC-Z, MS-Z, DS-M, GG-V, AL-S, and MZ-S contributed to the conception and design of the revision. All authors wrote some part of the manuscript and all reviewed the manuscript.

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*References marked with an asterisk are those articles analyzed in the systematic review.

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Emotions and Reactions to the Confinement by COVID-19 of Children and Adolescents With High Abilities and Community Samples: A Mixed Methods Research Study

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The goal of this research is to know and compare the emotions and reactions to confinement due to the COVID-19 pandemic in children and adolescents with high abilities and community samples. This is a mixed study with an exploratory reach that is descriptive, and which combines survey and qualitative methodologies to examine the emotions and reactions to confinement experiences of children and adolescents aged between 5 and 14 years. An online poll was designed with 46 questions, grouped into three sections: (1) General Data, (2) Reactions to the health contingencies of COVID-19, and (3) Positive and negative emotions. This last section was included the Oros' positive emotions questionnaire (2014) and the scales of the negative effect of the PANAS Schedule positive and negative affect on children and adolescents between 8 and 14 years old (Sandin, 2003). Data were collected online with a convenience sample. Quantitative data were analyzed with the SPSS statistics program and qualitative data with Alceste software. Among the main findings is the fact that there are no significant differences between the groups by ability in terms of reactions and emotions; however, there are differences between age groups and sex. The study discusses the implications for educational intervention in situations like the current pandemic.

Keywords: children, COVID-19, emotions, teenagers (adolescence), gifted students

INTRODUCTION

According to the World Health Organization (World Health Organization, 2010), a pandemic is a worldwide spread of a new disease. The coronavirus SARS-CoV-2 is a new virus to which humans have no antibodies and its consequences are serious due to the ease of transmission between people, which have high contagion figures and have caused a saturation of the health system. On 11 March 2020, the WHO declared COVID-19 as a pandemic because it has affected over 180 countries, and suggested a series of actions to mitigate its effects on the community, in particular social isolation.

Quarantines or isolation, either voluntary or mandatory, are one of the preventive health measures to avoid the disease spread. A quarantine can last days, weeks, or months, depending on the way the disease spreads and its severity. Even though isolation is a measure that aims to protect physical health, it is still likely to have an impact on mental health.

Social connection is one of the most deeply rooted evolution characteristics of human beings and is strongly related to survival. On the other hand, isolation is one of the factors that can threaten a person's state of mind. At the same time, people that feel alone or isolated have a higher probability of showing depressive symptoms (Santini et al., 2020).

A review of different studies related to quarantines has revealed that states of isolation have an important psychological impact on people (Brooks et al., 2020). It has even been shown that the conditions generated by social isolation create non-normative stressors, that increase the chance of mental problems appearing for the first time, and they even aggravate or have a manifest recurrence in pre-existing mental disorders (Caballero-Domínguez and Campo-Arias, 2020).

Social distancing has been one of the preventive recommendations during the COVID-19 pandemic. People have been asked to keep a minimum distance of up to 2 m from others to avoid contagion, and in the same way, it has been discussed that social distancing could have a direct impact on mental health (Kleinberg et al., 2020).

But, what is happening with children? Although most of the research shows that the psychological well-being and mental health of adults are affected by the current health crisis, it is important to determine to what extent it influences children, since they are vulnerable to the emotional impact of experiencing traumatic events that affect their daily lives (Bartlett et al., 2020). For this reason, it is expected that children will present emotional and behavioral changes while the contingency measures are in place. There is evidence from UNICEF (Guterres, 2020) that one of the pandemic's effects is a rise in family levels of stress, so it is of special interest to analyze how this affects children. Various authors and institutions point out that children react to the social state of adults (Centers for Disease Control and Prevention, 2020). Hence, it is stated that the children are fine when they are in tune with the emotional states of the adults (Dalton et al., 2020) and that, while being active observers of the people around them they look at hints on how to deal with their own emotions (World Health Organization, 2020) and identify and react to the parents' stress, or their caregivers or other members of their family and community (Bartlett et al., 2020).

An important element in the perception of emotions is the level of activation and valence, for example, in boys it has been observed that there are gender differences in emotional reactivity to girls, who tend to react more intensely to emotions related to aversion (Sharp et al., 2006). On the other hand, studies have shown that boys classify emotions similarly to adults in terms of valence; however, differences have been observed in reactivity, as boys tend to qualify their emotional states with more neutrality (Mouw et al., 2016).

In children with high ability, there is debate regarding their emotions (Francis et al., 2016). Some authors report that these children can show feelings like anxiety and depression due to their high sensibility (Silverman, 1993; Wellisch and Brown, 2012; Karpinsky et al., 2018; Armstrong et al., 2019). However, others point to the opposite, indicating that they have a good socio-emotional fit (Valadez et al., 2015; Egeland, 2019; França-Freitas et al., 2019). Meanwhile, Borges et al. (2011) say that cognitive abilities can be used to solve any problems, allowing them a similar adjustment to their fellow partners.

Another study of the emotions of children and adolescents analyzed differences by sex (Heras et al., 2016), finding contradictory results (Madden et al., 2000; Etxebarria et al., 2003; Cova et al., 2005; Prieto et al., 2008; Palazuelo et al., 2010; Heras et al., 2016; Khamis, 2018; Van der Cruijsen et al., 2019). It is said that girls have a greater emotional development; however, other studies have found that girls have higher sadness scores and boys show higher aggression scores (Etxebarria et al., 2003). For pre-teens (11–13 years old), it was pointed out that women show higher emotional distress and depression than males. This matches reported by other scholars, which found that women have higher emotional distress, like anxiety and depression, during adolescence. In the case of children and adolescents with high ability, Palazuelo et al. (2010) similarly observe more emotional signs in girls than in boys. However, authors like Prieto et al. (2008) point out that there are no differences in emotional intelligence between high ability and non-high ability students, and no sex differences were observed. In the case of pre-teens (11–13 years old), Cova et al. (2005) observe that women show higher emotional distress and depressive symptoms than males. This coincides with Madden et al. (2000), Khamis (2018), and Van der Cruijsen et al. (2019), who describe that adolescent women refer more emotional distress like anxiety and depression. More research is required on these emotional aspects to confirm these results.

Children and adolescents are at risk of developing mental health problems such as stress, anxiety, and depression before a traumatic event, even when their caregivers respond sensitively, in a receptive and willing manner to their concerns and questions (Bartlett et al., 2020). Although there is evidence that children aged 0–14 years are at lower risk of infection than older children (Zhang et al., 2020), and the physical effects of COVID-19 disease in children have been less than in adults or are generally asymptomatic (Xu et al., 2020), the effects on mental health can increase in a situation like the pandemic. We then must ask ourselves, what happens to them in a situation as exceptional as the pandemic?

Enmienda et al. (2020) say that the current conditions of confinement brought about by safety measures such as social distancing, staying at home, and online schooling can increase, among others, the anxiety and/or sadness in children with high ability. Although they can handle information about the virus cognitively, they can show intense feelings of fear for their family, for themselves, or problems arising from the pandemic (i.e., economic struggles or parents becoming unemployed). Children observe their parent's behavior and if they see them anxious or worried they can imitate that behavior; however, Boonstra

(2020) points out that this anxiety is similar to people could show more generally.

Uncertainty about the implications and the personal effects of COVID-19 creates concern in adults (Brooks et al., 2020), in addition to the psychological effects of the quarantine. As a consequence of their concern, adults may not recognize and respond sensitively to the signs of distress in children in general (Dalton et al., 2020), and particularly in children with high ability in particular (Enmienda et al., 2020). Anxiety can cause children to avoid sharing what worries them as a way to protect others, leading them to confront these feelings alone (Dalton et al., 2020), or leading to the intensification of emotions in the case of children and adolescents with high ability, as they need to be cognitively challenged (Boonstra, 2020).

As has been said before, children are active observers and participants of their environment, and they are not indifferent to the impact of the current health crisis, they feel and react to or simulate adult's reactions, such as anxiety and stress (Weaver and Wiener, 2020). It is important to consider that, although all children are active observers of the situation and were prone to emotional problems even before the contingency measures were implemented, children with high abilities have additional layers of social and emotional complexity. Some of the most reliable empirical findings about the social and emotional traits of students with high ability have tried to explain that they are more intense. For example, Terman and Hollingworth's first research in the early twentieth century suggested that students with high ability experience emotional phenomena more deeply than their peers, and call these concerns "gifted intensity" (Wiley, 2020). Some research questions come out of this, including what emotions and reactions do children and adolescents show from the confinement of COVID-19? Are emotions and reactions different between children and adolescents with high ability and with other young adults? Are there differences between age groups and sex?

This work aims to study the emotional reactions of children, with high ability using community samples, to understand their emotions and reactions to the confinement that has been required since the health alert for COVID-19. These results will enable us to develop intervention strategies for this group of people during and after the contingency measures, clarifying debates about the emotional differences between both groups.

MATERIALS AND METHODS

Participants

The sample consisted of 649 children aged between 5 and 14 years old (average = 9.6, ST = 2.6). **Table 1** shows data relating to age (kinder: between 5 and 7 years old; children: between 8 and 12 years old, and adolescents: for 13 years and older), sex, and sense of belonging to the community or high ability. Of the sample 627 live in Mexico, 20 live in Spain, and two live in the United States. The selection of the sample was by convenience. The sample of parents with high ability children was obtained through contact with high ability groups belonging to university or civil association networks.

TABLE 1 | Sex, age, and sample type.

		Male	Female	Total
High ability sample				
Age	Kinder	59	38	97
	Children	117	55	172
	Adolescents	28	22	50
Community sample				
Age	Kinder	65	45	110
	Children	76	64	140
	Adolescents	34	46	80
	Total	379	270	649

Measures

A research instrument of 46 open and closed-ended questions was designed, distributed in three sections, namely:

(1) General data, where we explore age, sex, type of school he usually attends, enrollment in psychologic programs, and place of residence.
(2) Knowledge and attitudes toward health contingencies due to COVID-19. Specifically, what they know about the virus, precaution measures, the child's perception of the state of mind of the adults with whom they live, and also things such as whether they like or dislike staying at home (one of the measures implemented to mitigate the effects of COVID-19).
(3) The emotional reactions shown by children and adolescents in dealing with the COVID-19.

For participants aged 8–14 years old we also used:

- *The Children's Positive Emotions Questionnaire* (CEIP by its Spanish acronym) (Oros, 2014). This uses a scale that consists of 23 items in a Likert-like structure of 3 points, where the experience of satisfaction, gratitude, joy, serenity, and sympathy for others is explored. For this research, its use was extended up to participants aged 14 years.
- *The PANAS Scales of Positive and Negative Affect for children (*PANASN by its Spanish acronym) (Sandin, 2003), which aims to obtain a measure of both positive and negative effects. For this study, the negative effect scale was used. This negative effect subscale included 10 elements on a three-point Likert-type scale (1, never, 2, sometimes, and 3 many times), which assesses the frequency with which participants experienced negative emotions such as overwhelming fear or tension.

Both questionnaires were authorized by the authors to use in this research.

The goal of the study was presented at the beginning of the questionnaire. In terms of the confidentiality of the data, we asked the parents of participants to indicate whether they consent to the child's participation in the study.

The reliability of the instruments was established through Cronbach's alpha, obtaining 0.655 for the scale of the emotional reaction to COVID-19, a positive emotion scale of CEIP, and 0.623 on negative emotions of PANAS.

Procedure

The study used a Mixed Methods Research focus, combining surveys and cross design, with a qualitative methodology.

The questionnaires were designed with Google formats and distributed to parents through social media (WhatsApp). The instrument contained open questions that were analyzed through the ALCESTE program. The information collected meets the consistency criterion in the texts that correspond to the answers to the open questions and with the criterion of a sufficient amount of information (La société IMAGE, 2015).

This work was conducted ethically according to the principles of the Declaration of Helsinki. The questionnaire contained an informed consent statement at the beginning of the survey, which informed parents about the objectives of the study and other ethical details. The UDG ethics committee authorized the research under the certificate registration number: CI-03820. Data were confidential and we avoided recording information that would allow individual identification of participants.

Data Analysis

To determine the reliability of the instruments, Cronbach's alpha test was calculated. To know the relation between variables, Pearson correlation was calculated. To check the relation of the studied variables based on high ability and gender, MANOVA tests were calculated, using the SPSS software v.21.

For the qualitative analysis, we used the ALCESTE software (Reinert, 2001). El Analyse Lexicale par Contexte d'un Ensemble de Segments de Texte (ALCESTE) has been developed to respond to the needs and problems of social researchers when using instruments with open questions, in-depth interviews, or answers (texts) based on projective techniques. This practical software allows the user to statistically analyze a series of words that compose a discourse. It is based on the distribution of the vocabulary, establishing the semantic world of a textual corpus, and examining the structure of the distribution of this corpus through three stages: the construction of the data matrix, the classification of the context units, and the description of the sentences (Gil et al., 1994; De Alba, 2004).

The program identifies the co-occurrence of words in the same sentence, which enables the identification of semantic fields, represented in dendrograms (De Alba, 2004). The main advantage of this software is that the program establishes categories through the analysis it performs (Illia et al., 2012). ALCESTE has been widely used in high capacity studies (Villatte et al., 2011; Rodríguez-Naveiras et al., 2019), the study of COVID-19 representations in children (Idoiaga et al., 2020), and studies on episodic memory and self-awareness in Asperger Syndrome (Chaput et al., 2013), among others.

RESULTS

Quantitative Analysis

Variable Relation Between Emotions (Positive and Negative) and Reaction to COVID-19

First, the correlation between the three variables was found, which included factors corresponding to positive emotions (Joy, Serenity, Sympathy, Personal Satisfaction) with negative emotions, as well as with the scale of emotional reactions to COVID-19. A subsample of ages between 8 and 14 years old was used (see **Table 2**).

As shown, the positive emotions correlate significantly with each other. With negative emotions, the relation is negative but in Sympathy. With the scale of emotional reactions to COVID-19, Sympathy was the only one to correlate significantly.

Differences Between Positive and Negative Emotions

To establish the differences between the high ability and community samples, sex, and age, which are detailed below, data of the subsample of ages between 8 and 14 years old were analyzed.

Comparison between student ability (high ability and community samples) and sex

Given there were relations between positive and negative emotions, a MANOVA test was performed with two factors: ability (high abilities/community sample) and sex, with the 8+ years old sample. The descriptive statistics (means and standard deviations) are shown in **Table 3**.

The MANOVA is not significant even for the interaction of sex by ability (Wilks' $\lambda = 0.998$, $F_{5,434} = 0.365$, $p = 0.963$, η^2 partial = 0.002), not even for ability (Wilks' $\lambda = 0.996$, $F_{5,434} = 0.365$, $p = 0.873$, η^2 partial = 0.004). Nor are there any differences in any of the scales analyzed. In contrast, it is significant for the sex variable (Wilks'

TABLE 2 | Correlations among variables.

	Joy	Serenity	Sympathy	Satisfaction	Negative emotions
Serenity	0.737***	1			
Sympathy	0.318***	0.236***	1		
Satisfaction	0.542***	0.546***	0.364***	1	
Negative Emotions	−0.325***	−0.297***	0.110**	−0.218***	1
COVID-19	−0.013	−0.030	0.119**	0.002	0.023

$^{**}p < 0.01$. $^{***}p < 0.001$.

TABLE 3 | Descriptive statistics of ability and sex.

		High ability			Community		
		Mean	**ST**	***N***	**Mean**	**ST**	***N***
Negative emotion	Male	9.34	1.67	145	9.21	1.65	110
	Female	9.43	1.79	70	9.34	1.70	110
Happiness	Male	26.39	2.75	145	26.73	2.44	110
	Female	26.45	2.89	70	26.72	2.57	110
Serenity	Male	14.78	1.97	145	14.90	1.93	110
	Female	14.73	2.19	70	15.01	1.89	110
Friendliness	Male	9.20	1.49	145	9.24	1.54	110
	Female	9.61	1.54	70	9.77	1.54	110
Satisfaction	Male	7.36	1.15	145	7.49	1.11	110
	Female	7.58	1.17	70	7.69	1.02	110

λ = 0.970, $F_{5,434}$ = 2.700, p = 0.020, η^2 partial = 0.030), with a small effect size. Women result in significantly higher scores for *Friendliness* ($F_{1,438}$ = 10.185, p = 0.002, η^2 partial = 0.023), with large effect size and *Satisfaction* ($F_{1,438}$ = 3.856, p = 0.050, η^2 partial = 0.009), but the size of the effect is very small.

Differences according to age

To know if the age could be relevant in differentiating between these variables, they were split according to age into two groups: 8–11 (children) and 12–14 (adolescents). Contrasts of *t* Student for all the variables under study were calculated, except in the Joy scale for it being heteroscedastic the Welch solution was used (see **Table 4**).

Differences in the response scale to COVID-19

All the sample results were used in the analysis (participants between 5 and 14 years old), thus, adding an age group (Kinder, 5–7 years old). The results of average and standard deviations, per ability, sex, and age are shown in **Table 5**.

The ANOVA of ability was calculated for sex and age, as shown in **Table 6**. There are differences in sex, with a small size effect where females are more concerned; and in age, also with a small size effect where the significant differences between children and adolescents (Tukey' HDS = −0.25, p = 0.017), and the youngest show more concern.

TABLE 5 | Descriptive statistics of ability and sex and age.

		High abilities			Community		
		Mean	**ST**	***N***	**Mean**	**ST**	***N***
Kinder	Male	2.44	0.74	59	2.25	0.85	65
	Female	2.39	0.75	38	2.56	0.77	45
Children	Male	2.21	0.88	117	2.20	0.80	76
	Female	2.42	0.81	55	2.39	0.79	64
Adolescents	Male	2.00	0.90	28	1.76	0.89	34
	Female	2.27	0.88	22	2.46	0.78	46

TABLE 6 | ANOVA differences by ability, sex, age, in concern for COVID-19.

Contrast	***F***	***p***	**η^2 partial**
Full interaction	1.102	0.333	0.003
Age vs ability	0.001	0.999	0.001
Sex vs ability	3.264	0.071	0.005
Age vs sex	1.859	0.157	0.006
Ability	0.093	0.763	0.001
Sex	14.813	0.001	0.023
Age	4.617	0.010	0.014

Qualitative Analysis

The data from the four open-ended questions of the study were analyzed, distinguishing the two samples of the research: high ability and community samples. These results are discussed below. An Elementary Context Unit (ECU) is a unit of text within which ALCESTE calculates the frequency of word co-occurrences (Reinert, 2001).

> *First question: "I understand I have to stay at home because. . ."*

The ALCESTE analysis for the question *"I understand I have to stay at home because. . ."* in which the community sample yielded six classes, classifying 48% of the wording units. It is organized as follows: class 1 connects with two branches, a set formed by classes 5 and 6, and a second branch, where class 2 connects with 3 and 4 (see the left side of **Figure 1**).

With the sample of high ability students, the percentage of the corpus groups analyzed is 42%. In this case, the answers

TABLE 4 | Differences according to age.

		N	**Mean**	**ST**	***t***	**fd**	***p***	***d***
Negative emotion	Children	312	9.43	1.67	2.174	440	0.030	0.25
	Adolescents	130	9.05	1.69				
Happiness	Children	312	26.61	2.59	0.565	226.42	0.572	0.07
	Adolescents	130	26.45	2.79				
Serenity	Children	312	14.84	1.93	−0.239	440	0.811	−0.02
	Adolescents	130	14.89	2.09				
Friendliness	Children	312	9.48	1.54	1.361	440	0.174	0.13
	Adolescents	130	9.26	1.49				
Satisfaction	Children	312	7.51	1.11	0.165	440	0.869	0.01
	Adolescents	130	7.50	1.10				

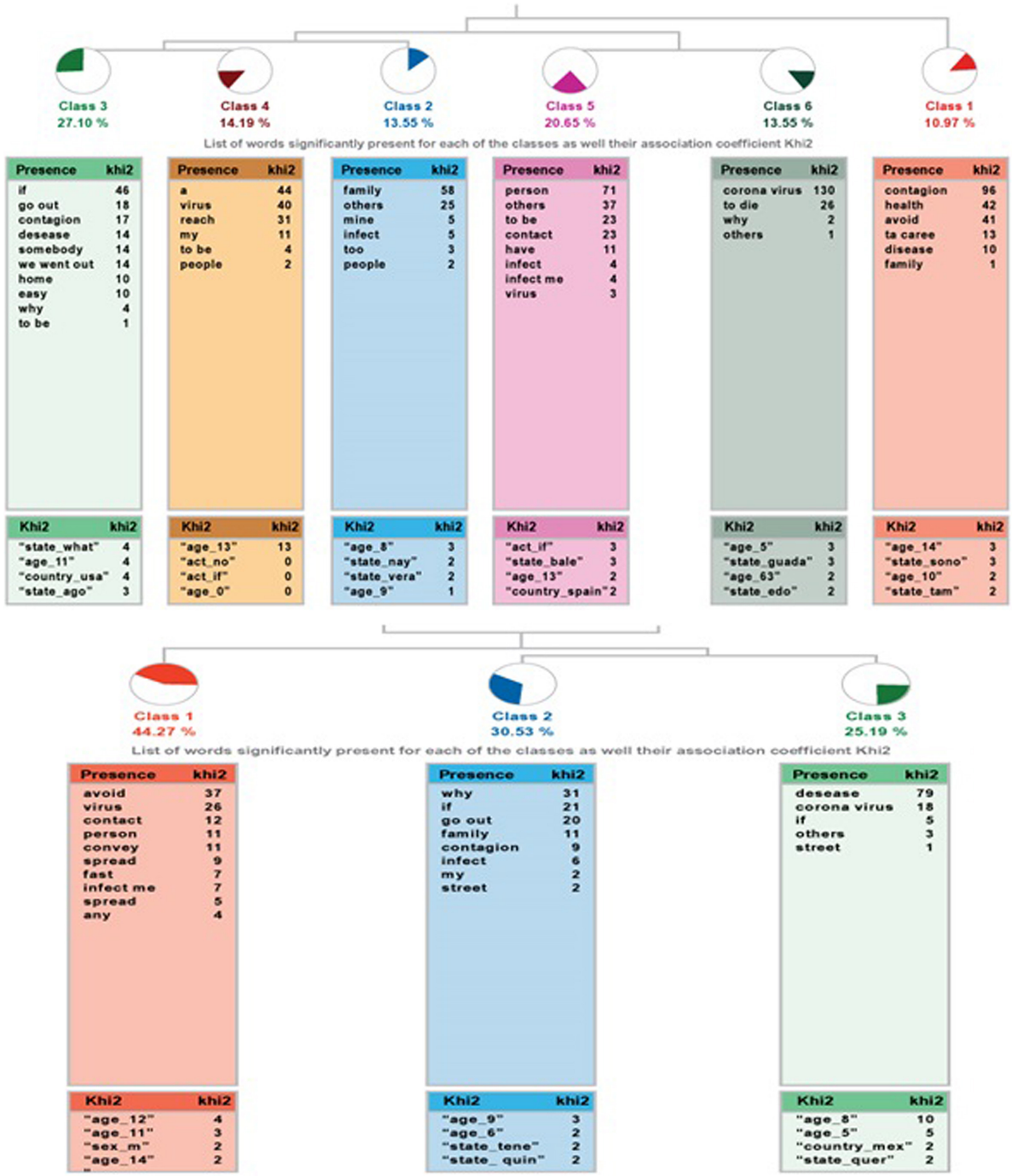

FIGURE 1 | Dendrogram of "I understand that I have to stay home because. . .," community sample at the **(top)**, high-capacity sample at the **(bottom)**.

are grouped into three classes, where the first one links to a grouping between classes 2 and 3, as can be seen on the right side of **Figure 1**.

Table 7 presents more detail relating to each class. These include name, number of ECUs, percentage of variable been explained, the most representative word, and example sentences for each class. In the community sample, class 1 has a more general component, while class 2 and the branch that derive from it with classes 3 and 4 talk about the contagion in terms of the possibility that it might infect others and the danger posed by the contagion. The other two classes, 5 and 6, refer to isolation and the need to avoid contagion and the lethal risks of the infection. In the sample of the participants with high ability, answers are more concentrated.

TABLE 7 | Information on the analysis of the question "I understand I have to stay at home because. . .."

Class		ECUs	%	Word
Community sample				
1 Name	*Avoid contagion*	17	10.97	Contagion
Phrases	It is a highly contagious disease This way the risk of spreading infection is reduced, slowing it down and avoiding an overload of the country's health system. I must avoid contagion			
2 Name	*Don't infect me nor others*	21	13.55	family
Phrases	Yes, my safety and others that I live with, including my family To not infect me or infect others I can catch the disease and pass it to my family			
3 Name	*Don't go out to avoid contagion*	42	27.10	If
Phrases	Because if I go out someone could infect me Because if we go to the streets someone with the disease could infect us. Because if I go out I can get sick.			
4 Name	*Dangers of contagion*	22	14.19	One
Phrases	If I catch the virus I could pass it to my parents and we could have a serious problem. It's a very contagious virus. I can be the carrier of the virus and pass it along to others.			
5 Name	*Social isolation*	32	20.65	Person
Phrases	Because we need to avoid contact with other people that could be infected. I can get infected by being with other people. Because by being in touch with other people you are more likely to get sick.			
6 Name	*Coronavirus infection*	21	13.54	Coronavirus
Phrases	I could get coronavirus and I could die. Because I could get infected with coronavirus and I could die. To not get infected by the coronavirus.			
High ability sample				
1 Name	*Avoid spreading the virus*	58	44.27	avoid
Phrases	To avoid the spread of the virus This way I avoid spreading the virus It is the best way not to spread the virus			
2 Name	*Chance of contagion*	40	30.53	because
Phrases	Because if I go out I will get infected. It's possible that nothing may happen to me, but if I get the virus, I'm a carrier and I could pass it along to my family. Because if not I could get infected.			
3 Name	*Chance of getting sick*	33	25.20	Get sick
Phrases	I could get sick with coronavirus COVID_19 Due to the coronavirus, if we go out we might get sick I could get sick.			

Comparing the results between both samples, we observed a greater dispersion among children in the community sample, as explained above. While the responses of the high ability group are focused on avoiding the spread of the virus, with two approaches: to become infected (without showing the effect this implies), or to become ill (which implies this infection)

Second question: "What I like the most of staying home is. . ."

The ALCESTE analysis for the question "*What I like the most of staying home is. . .*" in the community sample led to four classes, classifying 54% of the wording units. Class 1 branches into a structure that links class 2 and a final branch to classes 3 and 4 (see **Figure 2**, left).

For the sample of students with high abilities, there are five classes, which include 56% of the wording units. As displayed on the right side of **Figure 2**, there are two groups: on the one side, class 1, which links jointly with classes 4 and 5. The other branch gathers classes 2 and 3.

Table 8 shows the classes in terms of name, number of grouped ECUs, the percentage of the corpus that it explains, and the most representative word, as well as the example phrases of each class. In the community sample, the most relevant class, considering the number of ECUs it incorporates is class 1, *Watch TV*. In contrast to activities more centered on personal focus, like watching TV or playing, the last two classes seem to focus more on social aspects (being with the family) or widening to more open interests.

In the high ability sample, the class with more grouped ECUs is class 3, followed by class 1. The first class is linked to the set of classes 2 and 3, whose contents show deeper interests (free time, being with family). The other branch is made by classes 4 and 5, and is more focused on activities: playing or doing homework.

A comparison of both samples shows that the answers are very similar, except for the fact that the students with high abilities indicate that they perceived school homework as something positive during their obligatory stay at home.

Third question: "What I dislike the most about staying home is. . ."

In the ALCESTE analysis for the question*:* "*What I dislike the most about staying home is. . .*" the community sample yielded five classes, classifying 54% of the wording units. There are two branches: one that connects classes 4 and 5, and that one that links class 1 to 2 and 3.

The high ability sample shows the most relevant analysis of this research since it allows us to classify 70% of the wording units. Class 1 links the other two that are grouped.

Both dendrograms can be seen in **Figure 3**.

Table 9 shows the specifications of the classes, in terms of name, the ECUs that are included, the percentage of variable explained, the most representative word, and example sentences for each class. In the community sample, the most representative class is the 1, which groups more ECUs. As opposed to the link that has to do with boredom (class 4) and homework (class 5), the other set of classes focuses on what it is not allowed to

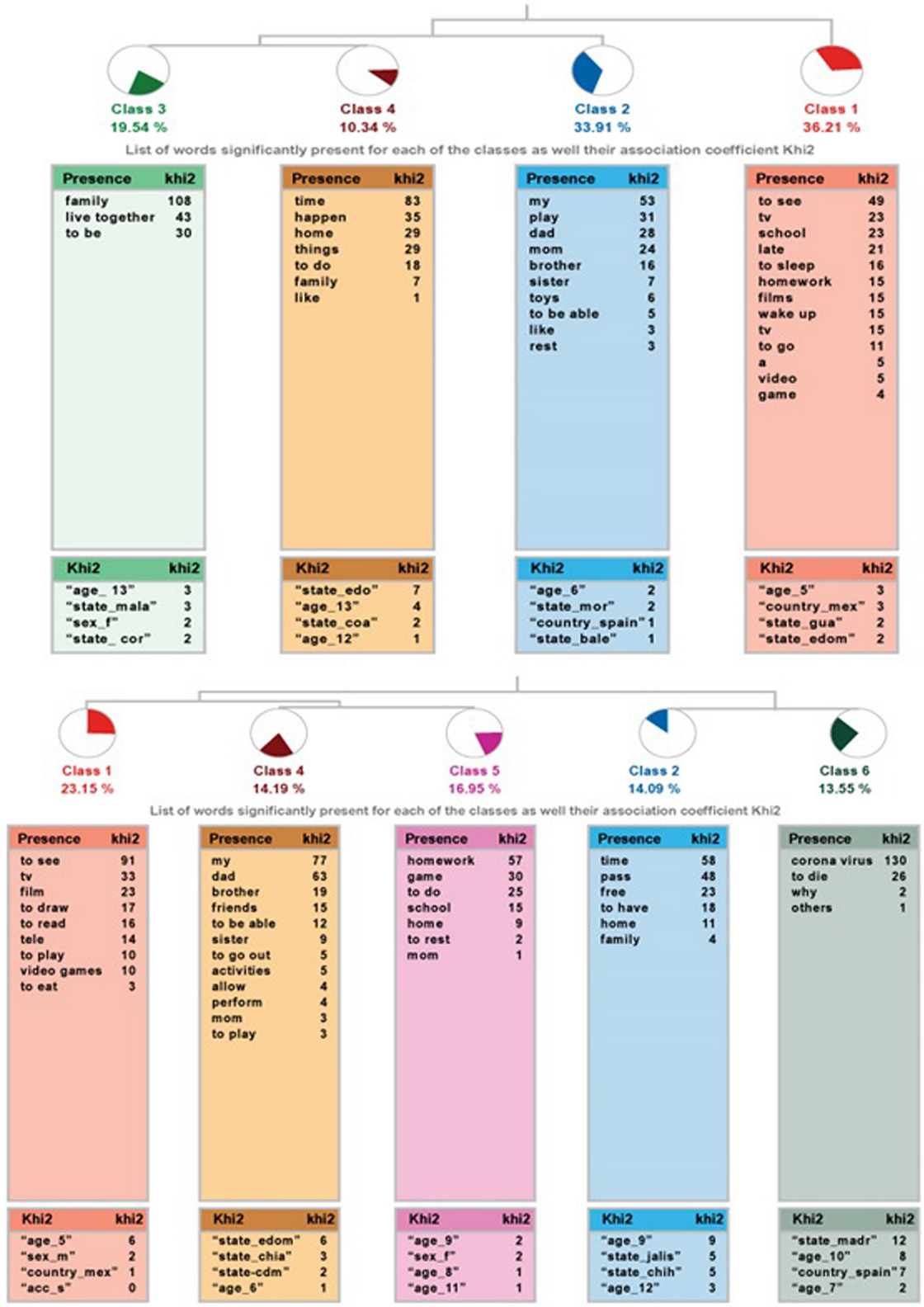

FIGURE 2 | Dendrogram of "What I like most about staying home is. . ." community sample **(top)** and high-capacity sample **(bottom)**.

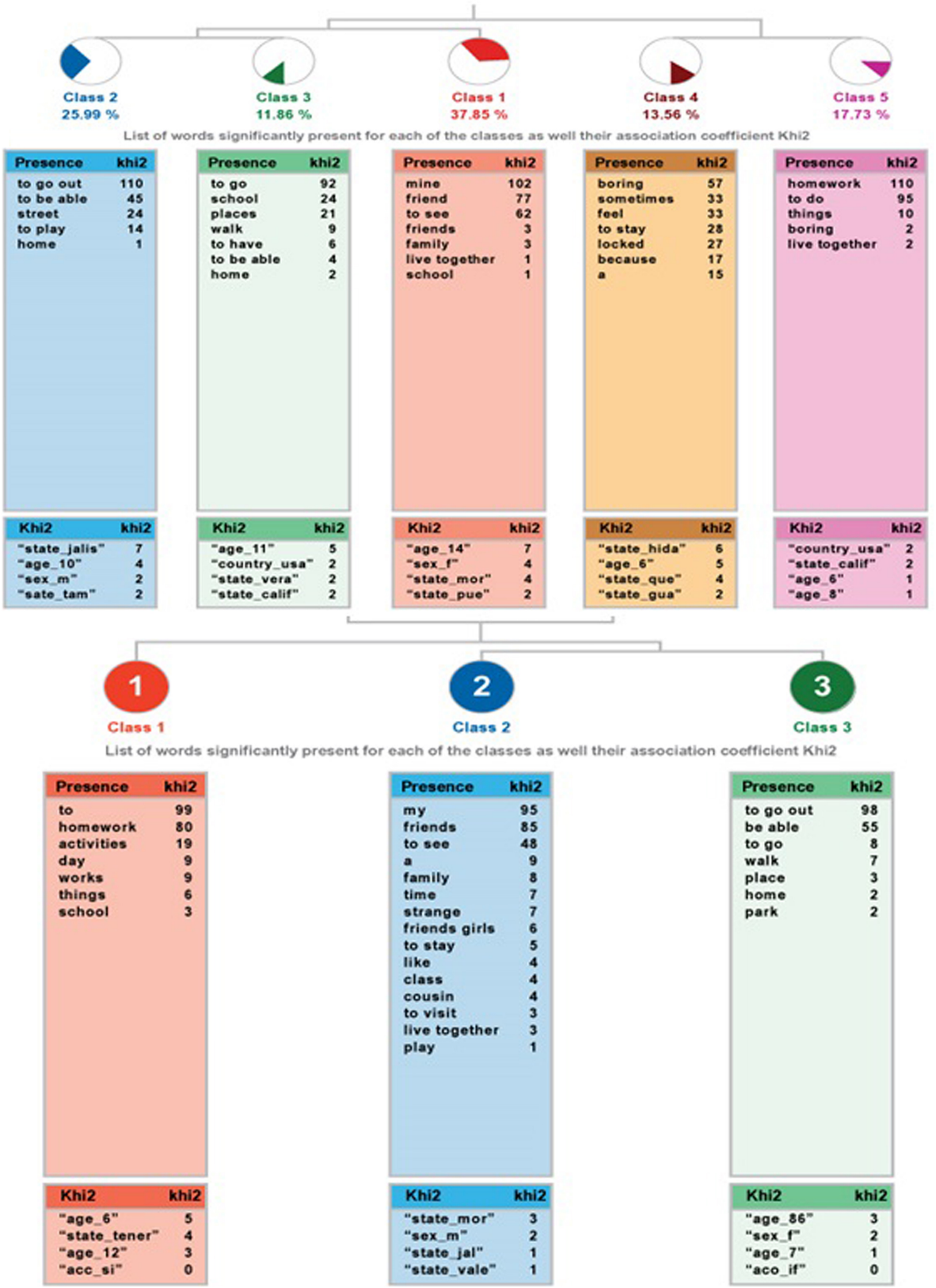

FIGURE 3 | Dendrogram of the analysis to the question "What I dislike the most about staying home is. . ." community sample **(top)** and high ability sample **(bottom)**.

TABLE 8 | Information on the analysis of the question "What I like the most about staying home is. . ." students of community sample and the high ability sample.

Class		ECUs	%	Word
Community sample				
1 Name	*Watch TV*	63	32.21	Watch
Phrases	Watch TV and sleep a little more Watch TV, watch videos I don't wake up early to go to school and also watch TV.			
2 Name	*Chance to play*	59	39.59	My
Phrases	Play, rest, help my parents I can play with my friends through videocall I can play with my sisters			
3 Name	*Being in family*	34	19.54	Family
Phrases	Being with my family Being with my family and enjoyment Interact with my family.			
4 Name	*Chance of doing other things*	18	10.34	Time
Phrases	I can take advantage and can do many things that I couldn't do before due to lack of time. I'm safe at home and it is not a big inconvenience, just washing the hands all the time. That I can do more things freely.			
High ability sample				
1 Name	*Watch TV*	41	23.16	Watch
Phrases	Watch TV read and play Watch TV and play I can read and play videogames			
2 Name	*Free time*	26	14.69	Time
Phrases	That I have more free time and I like working at home better That I have free time Having more time for me			
3 Name	*Being with family*	44	24.86	Family
Phrases	That I wake up a little later and I interact more with my family Being with my family I can be with my family and be safe.			
4 Name	*Chance to play with family*	36	20.34	My
Phrases	Able to do more activities with my parents Able to do activities that enhance my abilities and skills. Play with my little sister, with my older brothers, and with my parents			
5 Name	*Doing school homework*	30	16.95	Homework
Phrases	Do school homework I play more and do my homework with ease To rest and to do homework			

TABLE 9 | Information on the analysis of the question "What I dislike the most about staying home is. . ." community and high abilities samples.

Class		ECUs	%	Word
Community sample				
1 Name	*Impossibility of seeing my friends*	67	37.85	My
Phrases	I cannot see my friends I don't see my friends nor family Not seeing my Friends			
2 Name	*Impossibility of going out to the street*	46	25.99	Go out
Phrases	Not able to go out to play I'm not allowed to go out to the street Not able to go out to the Street			
3 Name	*Impossibility of going places*	21	24.86	Go
Phrases	I cannot go to places I like Not going to school Not able to go to museums or visit places that I would like to know			
4 Name	*Boredom*	24	13.56	Get bored
Phrases	It's because I get bored a little Being locked down and bored That I'm bored sometimes			
5 Name	*Doing school homework*	19	10.74	Homework
Phrases	Doing homework Doing the homework they sent me It is a homework-fest for teachers, we do much more of what we do normally in class, and when I don't understand there is no one to explain them to me			
High ability sample				
1 Name	*Have to do homework*	53	24.09	Do
Frases	That they give us school homework That I have to do homework That I have to do homework every morning			
2 Name	*Impossibility of seeing my friends*	106	48.18	my
Phrases	That I lose track of time and I don't see my friends Not seeing my friends and family That I can't see my friends			
3 Name	*Impossibility of going places*	61	27.73	Go out
Phrases	Not able to go to other places Not able to go out to fun places Not able to go out			

do by staying at home: seeing friends, going out to the street, or other places.

In the sample of high abilities, the class that groups most units is the impossibility of seeing friends, in this case, class 2. As in the previous case, but more concentrated, there are two connections: the general in class 1, where that it bothers them to do homework, as opposed to the impossibility of both going out (class 3) and seeing friends.

Despite being broken into more classes, both samples share two general categories: what they have and can do and what is not allowed. Both samples feel upset about school homework and because they are not allowed to go out to see someone or go out wherever they like. On the other hand, students from the community sample show boredom as something that bothers them, but this is not the case with the high abilities sample.

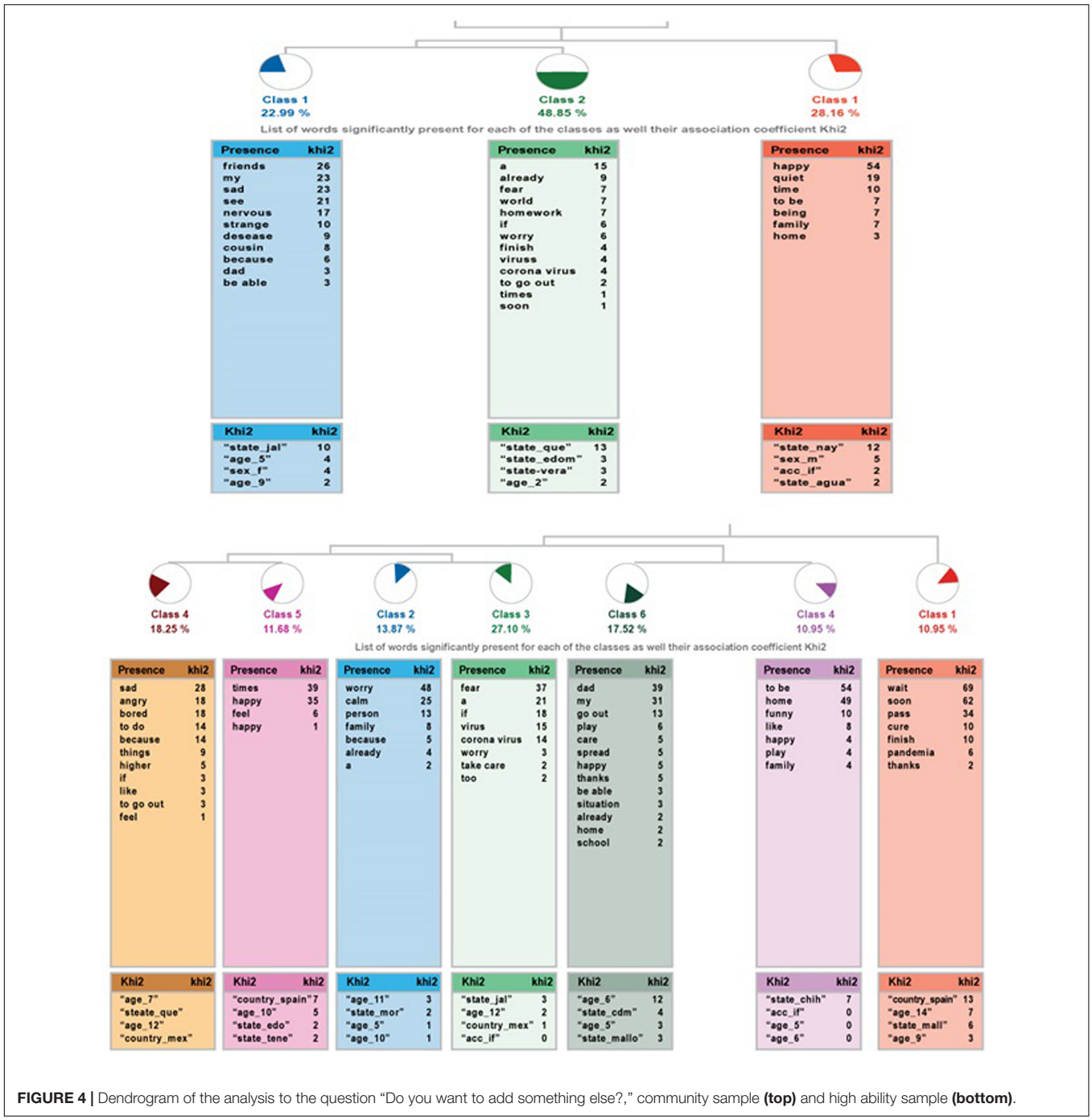

FIGURE 4 | Dendrogram of the analysis to the question "Do you want to add something else?," community sample **(top)** and high ability sample **(bottom)**.

It is important to highlight that in the previous question, high ability students were more likely to do homework, while in this question they dislike it. A possible explanation is that they could do school work at their own pace, instead of feeling forced to do it.

Fourth question: "Do you want to add something else?"

The ALCESTE analysis for the question *"Do you want to add something else?"* in the community sample has yielded three classes, classifying 61% of the wording units. There are two branches, one that links class 1 with the other two, which are also connected in between.

For the high ability sample, this question portrays the highest number of classes of the questionnaire: seven, which points to a higher diversity in the information to be provided. It allows us to classify 50% of the content. As in the previous analysis, class 1 works as a link for the others, connecting each other by pairs: classes 2 and 3, 4 and 5, as well as 6 and 7.

Figure 4 shows the dendrograms of the community sample (left side) and the high ability sample (right side).

TABLE 10 | Information on the analysis of the question "Do you want to add something else?" community and high abilities samples.

Class		ECUs	%	Word
Community sample				
1 Name	*Happy about being home*	49	28.16	happy
Phrases	I feel happy about spending more time with my family I feel happy about being with my family I feel happy			
2 Name	*Sadness*	40	22.99	friends
Phrases	I feel sad because I can't see my friends and cousins Sad because I don't see my cousins Sad because I can't share with my friends			
3 Name	*Concern*	85	48.85	a
Phrases	A virus that we must not fear with all the fear of the world but we have to be informed and take care to not exaggerate, well, that's all I want the COVID-19 pandemic to be over Good, I am a little worried			
High ability sample				
1 Name	*Hope*	15	10.95	Hope
Phrases	I hope that the pandemic ends soon and everything goes back to normal I am concerned about all that is happening and I hope that the quarantine ends soon I hope that this pandemic ends soon and I hope that many will be alive to enjoy it			
2 Name	*Concern*	19	13.87	Concern
Phrases	Calmed and at the same time concerned Calmed and a little concerned What I feel is concerned because I want to be with my family for a while so that I can see my family and my best friend called Karen			
3 Name	*Fear*	23	16.79	Fear
Phrases	A synthetic virus and yet we're still healthy and if it gets to us the coronavirus doesn't mean we will die in lockdown I feel good because I'm at home, I fear coming back to school. If we are sick use a mask and let our parents know in case we feel bad so they can take us to the doctor. I feel a little concerned because this Chinese pandemic is spreading too fast and I fear that the coronavirus will get to me. Also if I get sick I think I will go to China to get cured.			
4 Name	*Sadness*	25	18.25	Sad
Phrases	I feel sad and upset because I can't do my daily things I'm sad because we're not going on vacation I'm sad because my grandfather died			
5 Name	*Joy*	16	11.68	Times
Phrases	I feel happy Sometimes I feel excited I feel happy to have a great family			
6 Name	*Care to avoid getting infected*	24	17.52	Parents
Phrases	Do not get the infection, being with my parents, not able to go out We must take care to not get infected, play with my parents Calmed because I know that my parents will take care of me			
7 Name	*Being comfortable at home*	15	10.94	Being
Phrases	It's very fun to be at home I like being at home I feel that being at home is fun			

In the community sample (**Table 10**), the contents have two different approaches: class 1 experience joy from being at home. The other two classes have a negative component: either sadness or concern, the most relevant class in terms of the ECUs grouped.

In the high ability sample, there is more dispersion, as seen by the seven classes obtained. Classes 2 and 3 are connected due to their negative nature: concern and fear. In contrast, classes 4 and 5 have opposite emotions: sadness (being the class in which most ECUs are grouped) and joy. The other two, group the family and home safety against the virus.

In the comparison between both samples, it is observed that in response to a completely open-ended question ("Do you want to add something else?") the high ability group shows many more variations. Both groups swing on the dichotomy of the negative and positive sides, but the higher abilities' group also integrates a safety perspective of being protected by the family. Moreover, children from the community sample show higher percentages of concern and sadness than those with higher abilities.

DISCUSSION

It is important to highlight that the tool designed to analyze the concern generated by the pandemic is not linked to emotions that are positive or negative. The insights shown by this tool, which has sentences starting with wording like *"I feel. . .,"* could have a more rational component rather than emotional.

Both age and sex have significant differences. Female students show more concern, but also more sympathy and personal satisfaction, which is in line with findings in the literature which included emotional scores higher to female target, although the effect size findings are small. They are also more concerned but the effect is small (Sharp et al., 2006; Van der Graaff et al., 2018).

In terms of age, there are some differences in both negative emotions and concern about COVID-19. The odd thing is that, according to the results, adolescents are less worried than children, when it could be expected to be the opposite since they have a better knowledge of what is happening, which could also be the reason they think this way.

Comparing the samples by abilities does not allow us to establish the differences between groups on a quantitative level. They do not differ in any of the used tools. These results support research that points out that the students with high abilities differentiate in cognitive aspects, which is obvious, but not in their personal and social adjustment (Borges et al., 2011), neither in their emotional reaction (Valadez et al., 2015; Egeland, 2019; França-Freitas et al., 2019).

This changes when the verbal language given by the minors is analyzed. In two questions, the sample of high abilities is more concise: the reasons given for staying at home seem to be more

precise: for example, they involve a general grouping (avoiding contagion) and two more specific reasons, so as not to infect others or infect themselves and what bothers them about staying at home: forced school homework and the impossibility of going out and meet friends, which they share with the community sample. In both groups, the social character stands out and the need to socialize with their peers. In contrast, in the community group, boredom is a class that is not present in the high ability sample. We could make a hypothesis that, by having the freedom to do activities of their own choice, there is no boredom (which is a usual complaint when at school, if it does not meet their educational needs (Pomar and Díaz, 1998; George, 2011), because they have sufficient strategies for looking for entertainment.

In terms of interests and autonomous work, we found an emphasis that only appears within the high abilities sample: when asked what it is what they like the most, "doing homework" is one class. This could seem contradictory (as it is also what they dislike the most) but a possible explanation could be how they perceive homework as something they do at their own pace or that homework is forced, and or that it is not hard enough and does not meet their ability level.

Where the greatest difference is observed, in terms of greater richness and variety of responses, the last question is more open-ended than the previous one. The community sample shows only three classes that are shared with the high ability group (being at home, sadness, and concern) while the other four are only present within the latter: joy, fear, hope, and precautions. The community sample showed more negative feelings than the one with high abilities.

The main limitation of this study is that we used an online questionnaire, which means that there is no guarantee that it was answered by the child without parental influence. This could perhaps be the reason for the youngest group showing more concern because the parents could be sharing their concerns as they feel the need to protect their children.

Additionally, there were other limitations in this study, including the fact that the level of physical activity undertaken by the children was not investigated, so no comparisons can be made between physical activity before and during the pandemic.

The situation created by the pandemic, which has involved an international quarantine, has been a historical moment, as it has forced us to live in unexpected circumstances of great uncertainty. Nevertheless, there does not seem to be a clear emotional disadvantage for the samples presented in this study at the time it was conducted (March and April 2020). It is, therefore, necessary to continue investigating these emotional states as these circumstances become the new normal, and it is important to understand the first-hand experiences of children who have lived through this unusual period. This allows us to understand and deepen insights into the effects of lockdowns and social isolation and the effects these can have on children and adolescent populations, but also to learn and seek intervention and coping strategies if a similar situation occurs again in the future.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Research Ethics Committee of University of Guadalajara, registered with the National Commission on Bioethics with number CONBIOÉTICA-14-CEI-002-20191003. OPINION of manuscript CI-03820. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

MV and GL-A contributed to the conception and design of the study. MV, GL-A, NR, GO, FF, and CR designed the questionnaire. GO and FF organized the databases. ÁB performed the statistical and qualitative analysis. NR, MV, FF, and GL-A wrote the introduction. MV, ÁB, and GL-A wrote sections of the manuscript. All authors were involved in the collection of the data, contributed to manuscript revision, and read and approved the final version.

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Parents' Perceptions of Student Academic Motivation During the COVID-19 Lockdown: A Cross-Country Comparison

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The COVID-19 outbreak has ravaged all societal domains, including education. Home confinement, school closures, and distance learning impacted students, teachers, and parents' lives worldwide. In this study, we aimed to examine the impact of COVID-19-related restrictions on Italian and Portuguese students' academic motivation as well as investigate the possible buffering role of extracurricular activities. Following a retrospective pretest–posttest design, 567 parents (n_{Italy} = 173, $n_{Portugal}$ = 394) reported on their children's academic motivation and participation in extracurricular activities (grades 1 to 9). We used a multi-group latent change score model to compare Italian and Portuguese students': (1) pre-COVID mean motivation scores; (2) rate of change in motivation; (3) individual variation in the rate of change in motivation; and (4) dependence of the rate of change on initial motivation scores. Estimates of latent change score models showed a decrease in students' motivation both in Italy and in Portugal, although more pronounced in Italian students. Results also indicated that the decrease in students' participation in extracurricular activities was associated with changes in academic motivation (i.e., students with a lower decrease in participation in extracurricular activities had also a lower decrease in motivation). Furthermore, students' age was significantly associated with changes in motivation (i.e., older students had lower decrease). No significant associations were found for students' gender nor for parents' education. This study provides an important contribution to the study of students' academic motivation during home confinement, school closures, and distance learning as restrictive measures adopted to contain a worldwide health emergency. We contend that teachers need to adopt motivation-enhancing practices as means to prevent the decline in academic motivation during exceptional situations.

Keywords: COVID-19 pandemic, home confinement, school closures, distance learning, academic motivation, extracurricular activities, parents' perceptions, cross-country comparison

INTRODUCTION

The COVID-19 pandemic has changed everyday life, imposing unprecedented sanitary, political, economic, social, and educational challenges. Home confinement and temporary school closures have also affected educational systems worldwide (Reimers and Schleicher, 2020; World Bank Group, 2020). The transition to distance learning placed a heavy strain on teachers, students, and their parents (Cachón-Zagalaz et al., 2020; Hiraoka and Tomoda, 2020). The rapid shift in the delivery mode of instruction and an uncertain future may have led students to experience considerable challenges in maintaining their academic motivation. However, to the best of our knowledge, although some evidence exists, for instance, on student's learning habits during COVID-19 (Trung et al., 2020), there is no empirical evidence specifically on how the COVID-19 pandemic and the restrictive measures, adopted by national governments to contain the new coronavirus spread, impacted students' academic motivation and learning across countries.

In this study, we surveyed Italian and Portuguese parents during April and May of 2020 to examine the impact of the COVID-19 pandemic and the associated restrictive measures on their children's academic motivation. Additionally, we also aimed to investigate the association between changes in academic motivation and students' participation in extracurricular activities during the COVID-19 lockdown to get a broader sense of the impacts of the imposed restrictive measures.

We analyzed data from these countries since they share similar culture and values regarding family functions in society and show similar patterns of relations and obligations between teachers and students (Hofstede, 2001; Pepi et al., 2006). However, the new coronavirus struck Italy long before Portugal, which was able to adopt restrictive measures within a short period of time. In effect, as reported by the European Centre for Disease Prevention and Control (2020) on 1st of April 2020 in Italy there were 4053 cases and 839 deaths, while in Portugal on the same date there were 1035 cases and 20 deaths.

In the next sections we present: (a) an overview of the educational contexts in Italy and Portugal; (b) available evidence on the impact of COVID-19 on education; and (c) available literature on the role of student's academic motivation and extracurricular activities on their academic performance.

Educational Contexts in Italy and Portugal

In Italy, compulsory education starts at the age of 6 and ends at the age of 16 and includes three cycles of education: (1) five years of primary school (i.e., grades 1 to 5); (2) three years of lower secondary school (i.e., grades 6 to 8); and (3) two years of upper secondary school (i.e., grades 9 and 10). Students can then decide to complete upper secondary school (i.e., grades 11 to grade 13) (EACEA/EURYDICE, 2019). In Portugal, compulsory education starts at the age of 6 and ends at the age of 18, and encompasses nine years of basic education (grades 1–9) and three years of secondary education (grades 10–12). Basic education consists of nine years of schooling divided into three sequential cycles of four (i.e., 1st cycle - grades 1 to 4), two (i.e., 2nd cycle - grades 5 and 6), and three years (i.e., 3rd cycle - grades 7 to 9) (EACEA/EURYDICE, 2019).

The Impact of COVID-19 Pandemic on Education

The COVID-19 pandemic affected every societal domain, including educational systems worldwide. Among the restrictive measures imposed to contain the spread of the new coronavirus (SARS-CoV-2), home confinement was one of the most severe measures that national governments adopted worldwide. This measure has led to an exceptional and temporary suspension of teaching activities attendance. As of late April 2020, 85% of students worldwide were out of school due to school closures in 180 countries (World Bank Group, 2020).

In the most affected areas of Italy, schools and universities suspended academic activities on February 24th, followed by a nationwide lockdown from March 9th onwards (Decree-Law 23 febbraio 2020 no. 6, 2020). As the new coronavirus spread across Europe, other national governments undertook similar measures. In Portugal, schools closed from March 16th onwards (Decree-Law no. 14/2020 86(89)-86(19), 2020), although many families voluntarily self-isolated from the beginning of March. While in Italy schools closed 16 days after the 50th confirmed COVID-19 case, in Portugal schools closed only four days after reaching the same threshold (Santana et al., 2020).

During school closures, teachers adopted new strategies, such as distance learning programs and open educational applications and platforms, to reduce disruption and ensure that students could receive instruction remotely. In this regard, parental support became essential, especially for younger students, who are not fully autonomous in managing the assigned learning activities. Nevertheless, these strategies raised concerns as not all parents could work alongside their children, nor every household had the required electronic devices such as laptops with wi-fi connection (Reimers and Schleicher, 2020). Furthermore, it is well known that school and home are two separate environments that require students to play different roles. In this situation, however, students have found themselves without physical contact either with their teachers nor with their classmates.

Critically, if some students may find motivation to engage in school activities as a challenge in itself, the COVID-19 pandemic and the associated restrictive measures (i.e., home confinement, school closures, and distance learning) may have further hindered students' ability to sustain academic motivation towards school activities, such as attending online and asynchronous classes, studying, and doing homework.

Academic Motivation

Motivation is a catalyst of human behavior. Schunk and Pintrich (2002, p. 5) defined motivation as "the process whereby goal-directed activity is instigated and sustained." This definition highlights that motivation is shaped and constrained by both contextual factors and individual characteristics (Anderman and Dawson, 2011). Motivation is not an unidimensional concept; instead it is a complex, multidimensional construct that

encompasses different components, such as beliefs, goals, values, desires, needs, and emotions (Murphy and Alexander, 2000; Wentzel and Wigfield, 2009; Anderman and Dawson, 2011).

Across the past four decades, researchers have aimed to understand how motivation enhances students' learning and achievement in school. Academic motivation pertains to students' beliefs, goals, and values that determine which academic or school-related tasks they will pursue and persist in Wentzel and Wigfield (2009). According to Gottfried (1990, p. 525), academic motivation is the "enjoyment of school learning characterized by a mastery orientation; curiosity; persistence; task-endogeny; and the learning of challenging, difficult, and novel tasks."

Given the multidimensional nature of motivation, researchers have proposed different theories of achievement motivation (e.g., self-determination theory, social cognitive theory, self-theories, expectancy-value theory). Despite this profusion of motivation-related theories, there is a consensus among researchers that academic motivation is associated with positive academic and health-related skills and outcomes, such as self-regulation, persistence, critical thinking, academic achievement, school completion, career success, psychological well-being, and physical health (e.g., Guay et al., 2008; Archambault et al., 2009; Lai, 2011; De Naeghel et al., 2012; Cerasoli et al., 2014; Kriegbaum et al., 2015; Lazowski and Hulleman, 2016; Yilmaz Soylu et al., 2017; Camacho et al., 2020).

Within the context of the self-determination theory (Deci and Ryan, 1985; Ryan and Deci, 2000), students tend to become more intrinsically motivated when they experience satisfaction of the psychological needs for competence, autonomy, and relatedness in a learning task or context. *Competence* refers to the need of being effective in one's pursuits and interactions with the social environment (Deci, 1975). Students' need for competence is fulfilled when they know how to effectively achieve outcomes (e.g., through rules, feedback) (Skinner and Belmont, 1993). For instance, receiving positive feedback on a task fulfills students' need for competence, thus increasing intrinsic motivation. *Autonomy* refers to the perception of being causal agents of one's own life. Zuckerman et al. (1978) found that intrinsic motivation increased when individuals have options and choices to deal with when performing a task. On the contrary, external factors that restrict the perception of control, like deadlines, lead to a decrement of intrinsic motivation. Finally, *relatedness* refers to the importance of being emotionally connected and in interaction with other people. Fulfillment of the need for relatedness is likely to occur when teachers and peers create an authentic, caring, and supportive environment. When these three psychological needs are not fulfilled, students may experience maladjustment and lack of motivation.

Previous research also indicated that academic motivation typically declines over the school years. This decline seems to be consistent across grade-levels and across several motivational constructs (Lazowski and Hulleman, 2016; Scherrer and Preckel, 2019). Given that academic motivation boosts students' learning and achievement, drops in motivation are troublesome. Therefore, researchers need to determine which instructional practices bolster academic motivation and then translate these findings into evidence-based practices for teaching purposes. In this regard, a meta-analytic review by Lazowski and Hulleman (2016) showed that motivation interventions produced robust effects on behavioral educational outcomes and academic performance across diverse samples. For instance, within the context of the self-determination theory, motivation interventions include brief activities or instructional practices, such as allowing students to perceive more freedom and choice in learning activities, thus fulfilling the psychological need for autonomy.

Prior research has also shed light on gender-based differences in academic motivation. That is, gender differences in motivation seem to be domain specific as boys tend to report more favorable motivational beliefs in mathematics, science, and sports, while girls usually report more positive motivational beliefs in language, arts, reading, and writing (Meece et al., 2006). However, more recent evidence showed that girls reported higher levels of general academic motivation (Bugler et al., 2015). Both parents and teachers can contribute to gender differences in academic motivation by implicitly modeling gender-typed behaviors and by conveying different expectations, goals, and tasks for girls and boys (Meece et al., 2006).

Parents also actively influence student academic motivation. According to the self-determination theory, the fulfillment of students' psychological needs for competence, autonomy, and relatedness also depend on: (a) the way parents organize the environment (i.e., definitions of rules, guidelines, and expectations); (b) parent autonomy-support and respect for children's perspectives; and (c) the extent to which parents are involved and establish positive, caring relationships with their children (Grolnick et al., 2009). In addition, researchers have relied on reports from significant adults, namely parents and teachers, as reliable sources to assess student motivation and academic performance (e.g., Gilger, 1992; Harris et al., 2006; Saçkes et al., 2016; Allerhand, 2018; Owens et al., 2020).

Importantly, despite the wealth of research on academic motivation, there is scant evidence on whether and how extreme situations—such as home confinement, school closures, and distance learning as restrictive measures adopted in response to a global health emergency—may hamper students' motivation as perceived by their parents.

Extracurricular Activities

Participation in extracurricular activities, which applies to all levels of education, has received increased attention in research (Massoni, 2011). Extracurricular activities are optional activities, physically or mentally stimulating, encompassing structure, and providing experiences not included in formal academic or study activities (Larson and Verma, 1999; Massoni, 2011). They might refer to sports, clubs, student councils, or other activities that generally appeal to student interests, and encourage peer interaction, promote cooperation, strengthen student-adult relationships, and provide structure and challenge (Van Etten et al., 2008; Massoni, 2011).

Given the relevance of extracurricular activities, extracurricular settings are considered important contexts

for development, and students' transactions within those settings are described as proximal drivers of development (Fredricks and Simpkins, 2013). In effect, participating in structured extracurricular activities is associated with positive outcomes for students (Gilman et al., 2004). For instance, research suggests that student participation in extracurricular activities has been positively associated with academic performance and school connectedness (Holloway, 2002; Akos, 2006). Further, students participating in structured activities supervised by adults are more likely to invest in their schooling, becoming more motivated to excel academically (Jordan and Nettles, 1999). In this regard, several studies have documented positive associations between participation in extracurricular activities and students' academic motivation (Fredricks and Simpkins, 2013; Im et al., 2016).

In addition, participating in extracurricular activities mitigates behavioral risks. High-risk students (e.g., from disadvantaged backgrounds) involved in school extracurricular programs are less likely to drop out of school and to be involved in errant (e.g., delinquent) behaviors (Mahoney, 2000), while becoming academically more motivated (Mahoney et al., 2005; Im et al., 2016). Likewise, participation in extracurricular activities is described as a relevant protective factor impacting both achievement and psychosocial adjustment, contributing to foster more successful school transition experiences (Akos, 2006).

Research is inconsistent regarding the effect of students' gender on their participation in extracurricular activities. Indeed, although some authors suggest that boys and girls are equally likely to take part in extracurricular activities (Holloway, 2002; Guèvremont et al., 2008), others suggest that girls are either more or less likely to engage in this type of activities (Darling et al., 2005; Newman et al., 2007). Regarding age, overall, older students have been shown to have higher participation rates than younger ones (Guèvremont et al., 2008).

Available evidence also suggests that students whose parents have lower education levels are less likely to participate in extracurricular activities than students from more highly educated families (Darling et al., 2005). In addition, previous research has pointed to the lack of parent understanding of the academic benefits of extracurricular activities, and their consequent lack of support, as barriers to students' participation in extracurricular activities (Im et al., 2016).

Further, previous studies have addressed the role extracurricular activities can play (e.g., in reducing deviant behavior, or augmenting positive adjustment of students) in exceptional circumstances, such as managing racial conflicts (Crain, 1981), coordinating emergency crises, such as a mass school disaster (Klingman, 1987), or even promoting medical students' learning during a war (Gluncic et al., 2001). However, to the best of our knowledge, no studies have tackled their role and their associations with students' academic motivation, during a worldwide health emergency. Nonetheless, existing studies highlighted the beneficial effects of extracurricular activities for students' well-being, and their potential role as a buffer for academic motivation.

THE PRESENT STUDY

The main purpose of this study was to examine the impact of COVID-19 restrictions (i.e., home confinement, school closures, and distance learning) on students' academic motivation and the extent of their participation in extracurricular activities. Adopting an exploratory approach, we compared students' academic motivation in Italy and Portugal—two Southern European, culturally similar countries (Hofstede, 2001; Pepi et al., 2006) that faced the spread of COVID-19 at different times.

We invited Italian and Portuguese parents to report their perceptions of their children's academic motivation and participation in extracurricular activities for two time periods: (1) before the onset of COVID-19; and (2) during the COVID-19 lockdown period. We turned to parents and not directly to students due to two reasons. On the one hand, using online data collection procedures, it was difficult to reach children due to ethical and time constraints. On the other hand, we wanted to focus on students from grades 1 to 9 and young students may find it challenging to reflect on their academic motivation, especially by means of a self-report scale. We thus relied on parents' reports given that previous research has demonstrated the relevance and accuracy of parents' report measures (e.g., Gilger, 1992; Saçkes et al., 2016; Allerhand, 2018; Owens et al., 2020).

Specifically, two research questions (RQ) guided the study: (1) Did students' academic motivation decrease from the period before the onset of COVID-19 (hereafter, pre-COVID-19) to the COVID-19 lockdown period (hereafter, COVID-19)?; (2) Were changes in students' participation in extracurricular activities associated with changes in academic motivation from the pre-COVID-19 to the COVID-19 period?

For RQ1, we expected to find a decrease in students' academic motivation during the COVID-19 lockdown period given the challenges posed by lockdown measures in both countries. That is, our first hypothesis was that home confinement, school closures, and distance learning threatened the fulfillment of the psychological needs for competence, autonomy and relatedness, which are linked to intrinsic motivation (Deci and Ryan, 1985; Ryan and Deci, 2000).

For RQ2, since previous studies have demonstrated the positive relation between participation in extracurricular activities and students' academic motivation (Fredricks and Simpkins, 2013; Im et al., 2016) we expected changes in the extent of participation in extracurricular activities to be positively associated with changes in academic motivation in both countries. That is, a putative decrease in academic motivation (between pre-COVID-19 and COVID-19) would be associated with a decrease in extracurricular activities.

In our statistical analyses, we included three important demographic variables: students' age and gender, and parents' education. First, we considered students' age since younger students might have found it harder to cope with lockdown measures and maintain their academic motivation, given their evolving cognitive, metacognitive, and self-regulation abilities (Zimmerman, 1990; Dignath et al., 2008). In addition, younger students generally need more support from their parents when

dealing with academic assignments, because they are less autonomous than older students.

Second, we took potential gender differences into account as previous studies have shown differences both in academic motivation and participation in extracurricular activities between girls and boys (e.g., Darling et al., 2005; Bugler et al., 2015). We also took parents' education into account as this is a common control variable in educational studies that has been shown to relate with students' academic achievement and participation in extracurricular activities (Eccles, 2005; van Tetering et al., 2018).

MATERIALS AND METHODS

Participants

This study was approved by the Ethical Committee for the Psychological Research of the University of Padova (authorization number: 3530). We safeguarded participants' data privacy in compliance with the General Data Protection Regulation (GDPR).

A convenience sample of 567 parents from different regions in Italy (n = 173, 89% mothers) and Portugal (n = 394, 93% mothers) participated in this study. Participants were recruited via social media platforms (e.g., Facebook). After their consent to participate in the study, participants completed an online survey. Mean parent age was 42.90 (SD = 5.76) for the Italian sample and 41.00 (SD = 5.53) for the Portuguese sample. As for educational level, 83% of parents in the Italian sample reported to have completed at least high school, compared to 89% in the Portuguese sample. Concerning income, 50% of Italian parents reported at least a 30,000€ yearly income, compared to 10,000€ of Portuguese parents.

Students' mean age was 9.65 (SD = 2.14; 46% girls) for the Italian sample and 10.04 (SD = 2.52; 52% girls) for the Portuguese sample. In the Italian sample, 72% of students were in primary school (grades 1 to 5), whereas 28% were in lower secondary school (grades 6 to 8). In the Portuguese sample, 50% of the students were in the first cycle of basic education (grades 1 to 4), 34% were in the second cycle of basic education (grades 5 to 6), and 16% were in the third cycle of basic education (grades 7 to 9).

Measures

Academic Motivation

Parents completed a questionnaire reporting their perceptions about their children's academic motivation before the onset of COVID-19 (pre-COVID-19) and in the lockdown period (COVID-19). From an initial pool of 12 items, adapted from an Italian standardized test—AMOS 8–15 (Cornoldi et al., 2005)—we selected 5 to index academic motivation (see **Supplementary Material** for further details on item selection). Two examples of items were: "When the teacher assigns homework, my child does it by self-initiative and not because parents ask her/him to" and "My child studies the minimum to get a sufficient grade". Items were the same both at pre-COVID-19 and COVID-19 but with different instructions. For the former, parents had to think about children's academic motivation during a routine situation before the onset of the COVID-19 pandemic; for the latter, parents had to think about children's academic motivation during the lockdown period. Items were scored from 1 (*I completely disagree*) to 5 (*I completely agree*) and were highly reliable both at pre-COVID-19 (McDonald's ωt_{Italy} = 0.84, McDonald's $\omega t_{Portugal}$ = 0.88) and at COVID-19 time points (McDonald's ωt_{Italy} = 0.86, McDonald's $\omega t_{Portugal}$ = 0.89).

Participation in Extracurricular Activities

To assess students' participation in extracurricular activities (i.e., as perceived by parents), Italian and Portuguese parents were asked a single question: "How many hours does the child practice extracurricular activities during the week?" The response scale ranged from 1 to 5 (1 = *does not practice any*; 2 = *1–2 h*, 3 = *3–4 h*, 4 = *5–6 h*, 5 = *more than 6 h a week*). Parents answered the question bearing in mind the period before COVID-19 (pre-COVID-19: M_{Italy} = 3.19, SD_{Italy} = 1.03 and $M_{Portugal}$ = 2.88, $SD_{Portugal}$ = 1.17) and the COVID-19 lockdown period (COVID-19: M_{Italy} = 1.12, SD_{Italy} = 0.57; Portugal: $M_{Portugal}$ = 1.29, $SD_{Portugal}$ = 0.69).

Procedure

After providing online consent, Italian and Portuguese parents completed the online survey through the Qualtrics XM Platform (Qualtrics, 2019). Data collection took place from April (i.e., during the COVID-19 lockdown) until the middle of May 2020 (i.e., before the lockdown was lifted) in both countries. Parents were recruited using official university channels and social media networks (e.g., Facebook, LinkedIn). We used a retrospective pretest–posttest design (Little et al., 2020). **Figure 1** depicts the restrictive measures and the data collection timeline in Italy and Portugal.

Data Analysis Approach

First, to answer our RQ1 we used a multi-group latent change score model (LCSM; Kievit et al., 2018) to compare motivation changes across time and samples. The four parameters of interest of the LCSM are the: (1) pre-COVID mean latent motivation score; (2) mean latent change score (i.e., the rate of change in motivation); (3) latent change score variance (i.e., individual variation in the rate of change in motivation); and the (4) covariance between pre-COVID-19 motivation and the mean latent change score (i.e., the dependence of rate of change on initial motivation scores). All measurement model parameters were constrained to be equal across time and sample (see **Supplementary Table 3**). Following Kievit et al. (2018), we fitted a set of models, sequentially constraining these four parameters. Likelihood-ratio tests were used to test for significant differences across samples.

Next, to answer our RQ2 we computed a multi-group bivariate LCSM to test the association between the rate of change in academic motivation and the rate of change in extracurricular activities. This corresponds to combining a LCSM of extracurricular activities to the model estimated above, plus a covariance parameter between motivation and extracurricular activities rates of change.

Finally, we tested whether the rates of change of motivation and extracurricular activities were associated with three

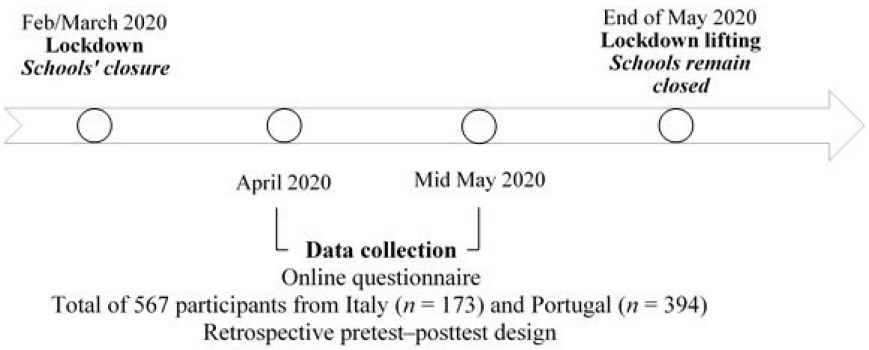

FIGURE 1 | Timeline of lockdown, school closures, and data collection in Italy and Portugal.

demographic variables (viz., children's gender, children's age, and parents' education levels).

All LCSMs were estimated using the lavaan package (version 0.6-5; Rosseel, 2012) in R (version 3.6.1; R Core Team, 2019).

RESULTS

Results are presented in the following order: (1) descriptive statistics for the motivational scale and participation in extracurricular activities item; (2) academic motivation latent change score model; (3) academic motivation and participation in extracurricular activities bivariate latent change score model; and (4) final model comprising the association between rates of change in academic motivation and participation in extracurricular activities with socio-demographic variables.

Descriptive Statistics

Table 1 summarizes descriptive statistics for academic motivation and extent of participation in extracurricular activities across Italian and Portuguese samples. In both countries, academic motivation and participation in extracurricular activities mean values decreased in the COVID-19 lockdown period.

TABLE 1 | Mean Scores for Pre and Post-COVID Motivation (M1–M5) and Extra-Curricular (EC) Activities.

	pre-COVID-19		COVID-19	
	M	*SD*	*M*	*SD*
Italy (*N* = 173)				
M1	3.09	1.10	2.79	1.10
M2	3.08	1.06	2.82	1.10
M3	3.20	1.13	2.87	1.13
M4	3.70	1.11	3.42	1.06
M5	3.47	1.09	3.22	1.09
EC activities	3.19	1.03	1.12	0.57
Portugal (*N* = 394)				
M1	3.10	1.24	3.01	1.25
M2	3.28	1.22	3.21	1.18
M3	3.19	1.19	2.99	1.15
M4	3.46	1.23	3.24	1.17
M5	3.42	1.15	3.26	1.16
EC activities	2.88	1.17	1.29	0.69

All items' scores ranged from 1 to 5.

Academic Motivation Latent Change Score Model

Model estimates showed that Portuguese and Italian students had similar initial levels of motivation (pre-COVID-19 mean latent motivation score = 3.10; likelihood ratio test: $\chi^2_{(1)}$ difference = 0.00, $p = 0.950$; see **Figure 2**). Importantly, model estimates indicated significant decreases in motivation (mean latent change score: Italy = −0.27, $p < 0.001$; Portugal = −0.14, $p < 0.001$), particularly in the Italian sample (likelihood ratio test: $\chi^2_{(1)}$ difference = 6.67, $p = 0.010$). We also found significant individual variability in the rates of change (latent change score variance = 0.36, $p < 0.001$), but this variability was similar across samples (likelihood ratio test: $\chi^2_{(1)}$ difference = 1.27, $p = 0.260$). Finally, decreases in motivation were significantly higher for students with higher pre-COVID-19 motivation scores (co-variance = −0.17, $p < 0.001$), and this association was similar across samples [likelihood ratio test: $\chi^2_{(1)}$ difference = 0.16, $p = 0.690$].

Approximate fit indexes of the motivation latent change score model, with unconstrained mean latent change scores (i.e., different rate of change across samples), showed acceptable to good values (robust measures - $\chi 2_{(105)} = 254.61$, $p < 0.001$; CFI = 0.96, TLI = 0.96, RMSEA = 0.08 [0.06, 0.09], SRMR = 0.07, Yuan-Bentler scaling factor = 1.13).

Academic Motivation and Participation in Extracurricular Activities Bivariate Latent Change Score Model

Similarly to the previous section, we fitted a set of models, sequentially constraining the following parameters: (1) pre-COVID-19 mean extracurricular activities; (2) extracurricular activities mean latent change score; (3) latent change score variance; and (4) pre-COVID-19 participation in extracurricular activities and mean latent change score covariance.

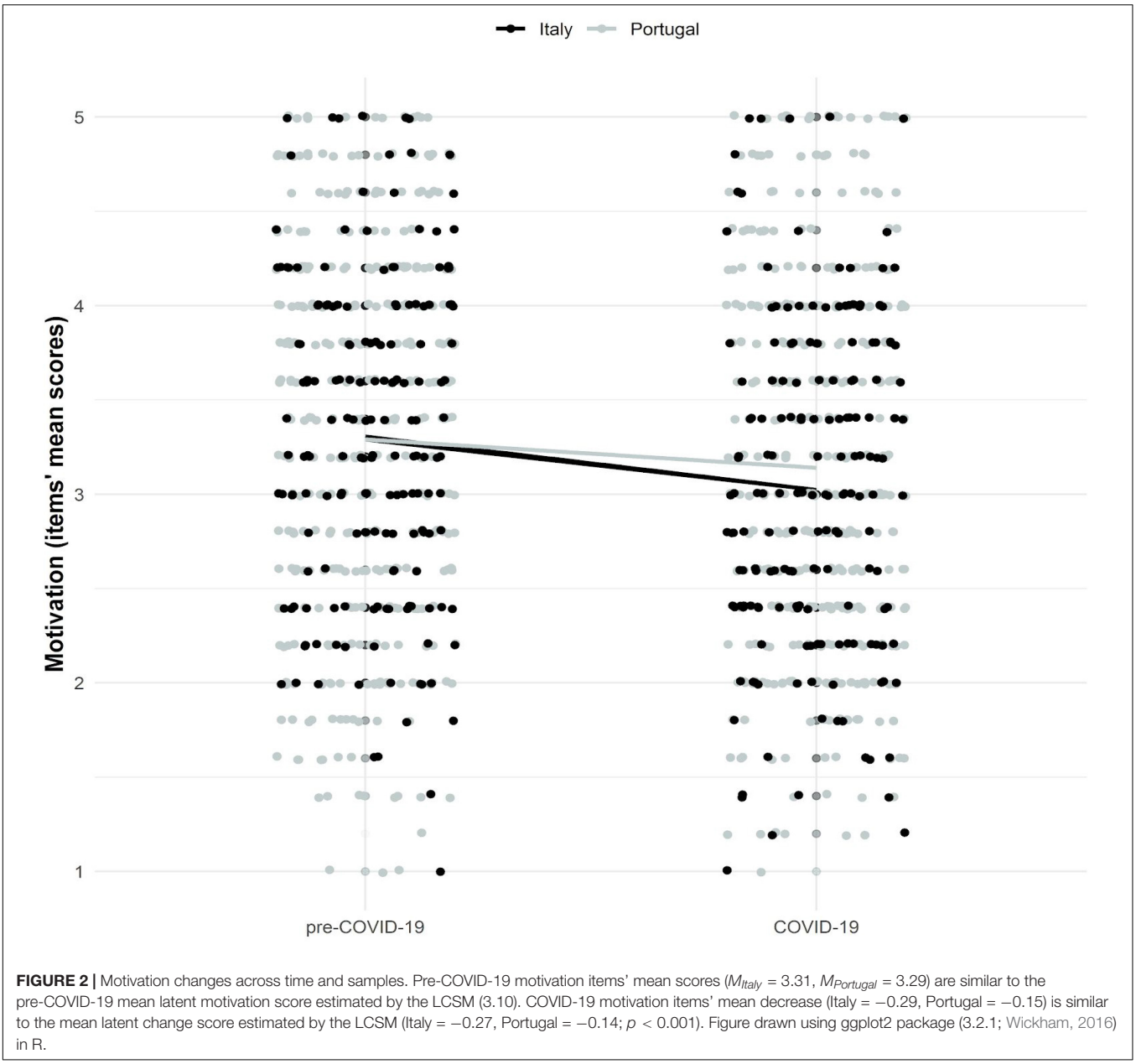

FIGURE 2 | Motivation changes across time and samples. Pre-COVID-19 motivation items' mean scores (M_{Italy} = 3.31, $M_{Portugal}$ = 3.29) are similar to the pre-COVID-19 mean latent motivation score estimated by the LCSM (3.10). COVID-19 motivation items' mean decrease (Italy = −0.29, Portugal = −0.15) is similar to the mean latent change score estimated by the LCSM (Italy = −0.27, Portugal = −0.14; $p < 0.001$). Figure drawn using ggplot2 package (3.2.1; Wickham, 2016) in R.

Model estimates show that the mean level of participation in extracurricular activities pre-COVID-19 differed across samples [likelihood ratio test: $\chi^2_{(1)}$ difference = 10.41, $p = 0.001$], with higher levels of participation in extracurricular activities for the Italian students (estimated mean extracurricular activities: Italy = 3.19, Portugal = 2.88; see **Figure 3**). Model estimates further showed significant decreases in extracurricular activities (mean latent change scores: Italy = −2.08, $p < 0.001$; Portugal = −1.59, $p < 0.001$), particularly in Italy [likelihood ratio test: $\chi^2_{(1)}$ difference = 13.76, $p < 0.001$].

Results also indicated significant individual differences in the rates of change (latent change score variance = 1.51, $p < 0.001$), but that this variability was similar across samples (likelihood ratio test: $\chi^2_{(1)}$ difference = 0.06, $p = 0.813$).

Similarly to academic motivation, decreases in the level of participation in extracurricular activities were significantly higher for students with higher pre-COVID levels of participation in extracurricular activities (co-variance = −1.17, $p < 0.001$), and this association was similar across samples [likelihood ratio test: $\chi^2_{(1)}$ difference = 0.37, $p = 0.546$].

Most notably, the rate of change in motivation and the rate of change in extracurricular activities were positively and significantly associated (co-variance = 0.04, $p = 0.030$). This association was similar across samples [likelihood ratio test: $\chi^2_{(1)}$ difference = 1.52, $p = 0.217$].

Approximate fit indexes of the motivation latent change score model, with unconstrained pre-COVID-19 mean levels of

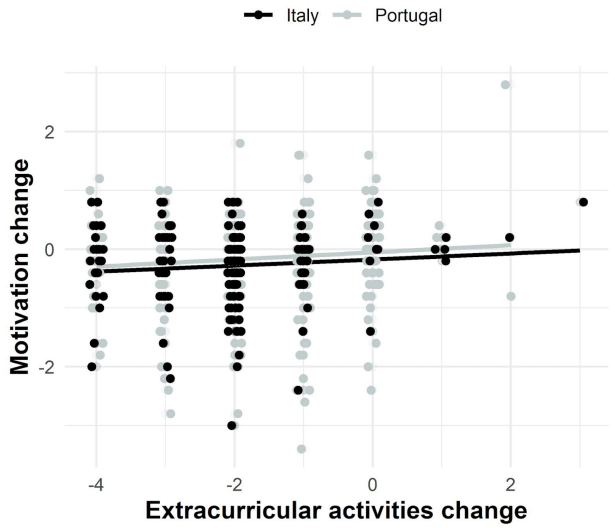

FIGURE 3 | Association between academic motivation and extracurricular activities change across samples. Motivation (extracurricular activities) change equals the difference between COVID-19 mean motivation items' scores (extracurricular activities score) and pre-COVID-19 mean motivation items' scores (extracurricular activities score). The positive regression lines approximate the positive and significant association between motivation and extracurricular activities mean latent change scores estimated by the bivariate LCSM for both samples (co-variance = 0.04, $p = 0.030$). Figure drawn using ggplot2 package (3.2.1; Wickham, 2016) in R.

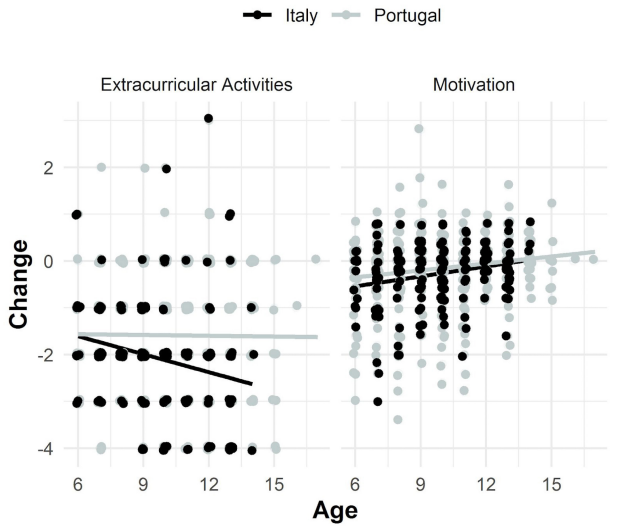

FIGURE 4 | Association between age and motivation and extracurricular activities change across samples. Motivation change equals the difference between post-COVID mean motivation items' scores and pre-COVID mean motivation items' scores. Extracurricular activities change equals the difference between post-COVID reported extracurricular activities levels and pre-COVID reported extracurricular activities levels. The bivariate LCSM estimated that for both samples children's age was positively and significantly associated with the motivation mean latent change score (co-variance = 0.31, $p < 0.001$), but not with the extra-curricular activities mean latent change score (co-variance = 0.10, $p = 0.101$). Figure drawn using ggplot2 package (3.2.1; Wickham, 2016) in R.

extracurricular activities and unconstrained mean latent change scores, showed acceptable to good values [robust measures-$\chi^2_{(146)} = 306.78$, $p < 0.001$; CFI = 0.95, TLI = 0.96, RMSEA = 0.07 [0.05, 0.08], SRMR = 0.07, Yuan-Bentler scaling factor = 1.09].

Final Model With Socio-Demographic Variables

For the final set of models, we tested whether the rates of change of motivation and extracurricular activities were associated with students' gender (covariate: girls = −0.5, boys = 0.5), students' age, and parents' education levels. As such, we added 6 co-variances to the previous model. Next, we tested whether these associations were equal across samples using likelihood ratio tests. Finally, we dropped non-significant variables.

Model estimates showed that the association between socio-demographic variables and the rates of change were similar across samples [likelihood ratio test: $\chi^2_{(7)}$ difference = 1.94, $p = 0.963$]. Students' age was positively and significantly associated with the rate of change in motivation (co-variance = 0.31, $p < 0.001$), with older students showing lower decreases in motivation, but not with the participation in extracurricular activities rate of change (co-variance = 0.10, $p = 0.101$; see **Figure 4**). However, students' gender and parents' education levels were not associated with either changes in motivation, or in the participation in extracurricular activities.

Approximate fit indexes of the final model showed acceptable to good values [robust measures: $\chi^2_{(168)} = 369.59$, $p < 0.001$; CFI = 0.94, TLI = 0.95, RMSEA = 0.07 [0.06, 0.08], SRMR = 0.07, Yuan-Bentler scaling factor = 1.08]. **Figure 5** depicts relevant unstandardized model estimates (see **Supplementary Table 4** for complete unstandardized model estimates).

DISCUSSION

The main purpose of this study was to examine the impact of COVID-19 restrictions (i.e., home confinement, school closures, and distance learning) on students' academic motivation and participation in extracurricular activities, as perceived by their parents. We sampled parents from two European countries that are culturally similar but that had to deal with the virus outbreak at different times. Therefore, we conducted a retrospective pretest–posttest study, where Italian and Portuguese parents reported their perceptions pertaining to children's academic motivation and participation in extracurricular activities before the onset of the COVID-19 pandemic and during the lockdown period.

Our first hypothesis was confirmed since we found a decrease in students' academic motivation during the lockdown period, as perceived by parents. In this regard, the self-determination theory (Deci and Ryan, 1985; Ryan and Deci, 2000) may be especially useful to interpret a drop in students' academic motivation. As aforementioned, according to this theory, student engagement in school is influenced by the degree to which they perceive that the school context meets

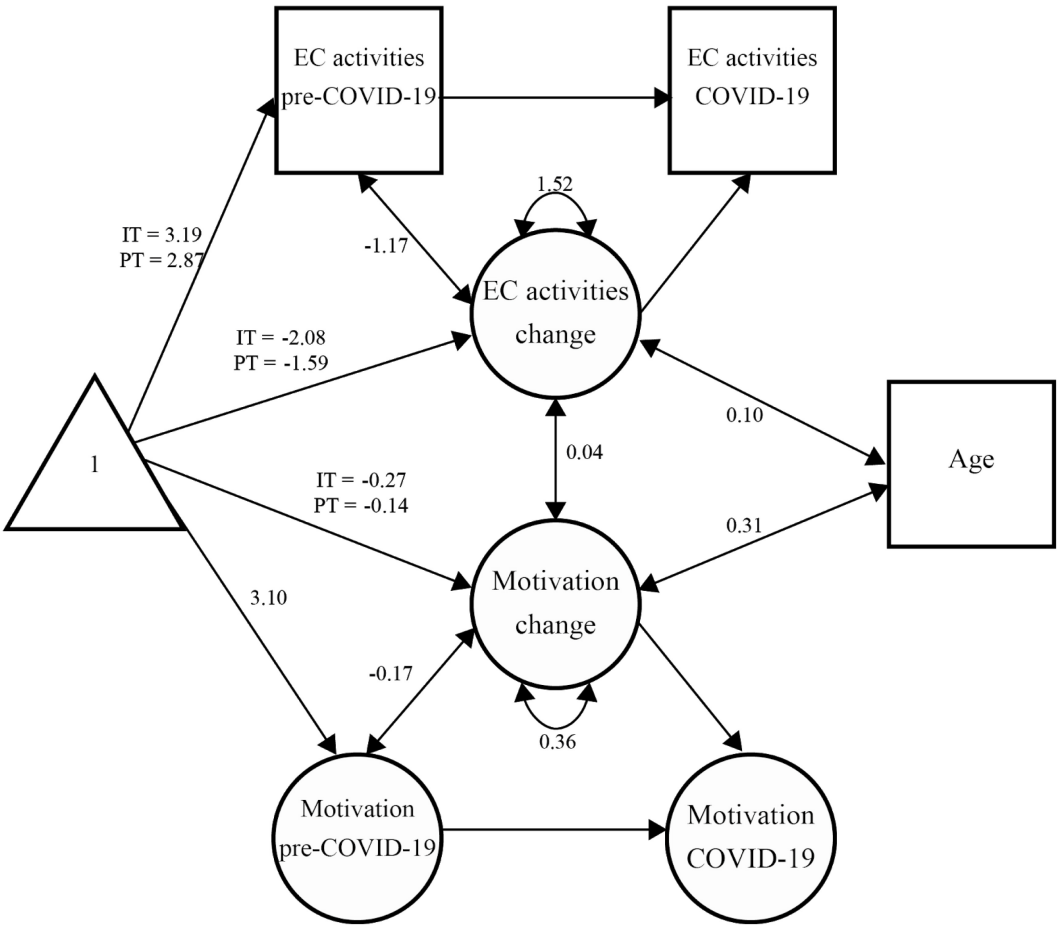

FIGURE 5 | Unstandardized final model estimates. For simplicity, only estimates of interest of the bivariate LCSM are presented. Shapes follow standard figural notation for structural equation modeling: triangle - intercepts (estimate mean levels), squares - manifest/observed variables, circles - latent variables, one-headed arrows - unidirectional effects (regression weights or means), and double-headed arrows - (co-) variances. EC = Extracurricular, IT = Italy, PT = Portugal.

their psychological needs. Home confinement, school closures, and distance learning may have threatened the satisfaction of competence, autonomy, and relatedness needs, thereby hindering students' academic motivation. In this regard, we put forth three possible interpretations for our findings.

First, we suggest that the situation of uncertainty, at times without clear instructions and expectations from teachers, led to the need for competence not being fulfilled. Indeed, students need clear tasks, feedback, deadlines, as well as individualized support, and activities with appropriate levels of difficulty. Moreover, teachers had fewer opportunities to become aware of individual students' emotional and academic difficulties. This may have further impacted students' perceptions of competence.

Second, students rapidly had to become more autonomous in organizing their time and completing tasks assigned by teachers. Therefore, younger children may have had more difficulty managing themselves and a more substantial need for support from parents, who have diverse levels of preparedness and availability to assist their children in school matters. While the satisfaction of the need for autonomy is fundamental to promote intrinsic motivation, it is important to underline that the ability to self-manage develops over time. Therefore, younger students may not have fully developed this ability. Moreover, it has been demonstrated that younger students are more likely to be affected by contextual factors (Sameroff, 2010). Older students' self-regulation strategies are more developed, which probably allowed them to cope more adaptively with the emergency situation and to preserve - albeit to a limited extent - their academic motivation.

Third, during lockdown, students' opportunities to interact with teachers and peers directly were drastically reduced, likely resulting in decreases in connectedness. In this regard, it has been widely demonstrated that the need for relatedness is likely to occur when teachers and peers create supportive relationships. Indeed, teacher support has been positively related to indicators of behavioral engagement, including higher participation in school activities and academic motivation and fewer disruptive behaviors (e.g., Wang et al., 2013). Moreover, previous research has demonstrated that students who have positive interactions

with peers are more motivated in engaging in school activities (Wang and Eccles, 2013).

Our second hypothesis was also supported. In line with previous research (e.g., Fredricks and Simpkins, 2013; Im et al., 2016), we found a positive and significant association between the rate of change in extracurricular activities and the rate of change in academic motivation. These findings are also in line with research suggesting that motivation in the school context (i.e., academic motivation) is associated with students' involvement in other contexts, such as leisure-time activities (Vallerand and Ratelle, 2002). Therefore, it seems that being involved in extracurricular activities is important to promote motivation in the school context (Wallhead et al., 2010). These findings are particularly relevant, as they highlight the important buffering role that extracurricular activities may have on students' academic motivation, also during exceptional times. Moreover, although research on participation in extracurricular activities has focused largely on high school students, our findings inform about the role of extracurricular activities in younger students. These years are particularly important, as students are undergoing rapid biological, cognitive, and social changes, such as the increased exposure to peers and the increased desire for autonomy (Im et al., 2016).

In this study, we adopted an exploratory approach in comparing students' academic motivation changes across Italy and Portugal. Interestingly, we found that students' decrease in academic motivation was higher for Italian than Portuguese students. In Italy, the first two official cases of COVID-19 were recorded between the end of January and the beginning of February of 2020, while in Portugal that only happened in the beginning of March (STATISTA, 2020). In particular, Italy was an European hotspot of the pandemic, which forced the government to adopt restrictive measures gradually, such as isolating specific geographical areas, closing schools and universities, limiting social interactions, restricting people and travel movement, and ceasing non-essential activities temporarily (Gatto et al., 2020; Sebastiani et al., 2020). Whereas in Portugal, national authorities had the chance to adopt the same restrictive measures early on (Santana et al., 2020), which curbed the new coronavirus spread during the first wave of infections. Therefore, the COVID-19 pandemic may have imposed a heavier psychological toll on the Italian population, including students who were called to remain focused and motivated in school activities (away from their teachers and classmates) in a situation of dramatic health emergency.

Limitations

This study has some limitations that open the door for future research. First, we conducted a retrospective pretest–posttest study (Little et al., 2020), rather than a longitudinal study. Therefore, conclusions drawn about the trajectory of academic motivation before and during COVID-19 lockdown period should be interpreted with caution. Future longitudinal studies could shed more light on the trajectory of students' academic motivation and participation in extracurricular activities during an exceptional situation, such as the COVID-19 pandemic. Researchers could thus understand whether a decline in both academic motivation and participation in extracurricular activities endures or reverts to baseline levels over time, as well as disentangle causality effects.

Second, we examined parents' perceptions rather than children's perceptions of academic motivation. We opted to rely on parents' reports mainly due to ethical issues involving children's participation in online questionnaires. However, as aforementioned, previous research has demonstrated that parents are relevant (Dinkelmann and Buff, 2016) and accurate (Eccles, 2005) sources, for instance in reporting their perception on students' literacy motivation (e.g., Saçkes et al., 2016). Future research could rely on children's perceptions of their own academic motivation and participation in extracurricular activities.

Third, our sample is non-representative of Italian and Portuguese populations. Indeed, parents' demographic characteristics were not equally distributed. We received overwhelmingly more answers from mothers than fathers. Additionally, parents portrayed in our study reported high levels of education and lived mainly in urban areas. Notwithstanding, we exerted the best of our efforts to disseminate the online study to parents from different Italian and Portuguese regions.

Fourth, other potentially relevant variables could have been taken into account in order to shed more light on the role of academic motivation and participation in extracurricular activities, such as contextual determinants (e.g., parental support during distance learning and teaching practices) and academic and psychological outcomes (e.g., academic achievement, self-regulation, and psychological well-being).

Implications for Practice

Despite these limitations, results of this study may suggest relevant practical implications. We propose the need for the adoption of motivation-enhancing practices to thwart the decline in students' academic motivation during exceptional situations, such as the COVID-19 lockdown. Teachers can nurture students' motivation by using several practices that aim to satisfy the psychological needs for competence, autonomy, and relatedness (Deci and Ryan, 1985; Ryan and Deci, 2000). For instance, teachers may: (a) allow student choice and autonomy in the learning process; (b) introduce online collaborative learning methods; (c) establish rules, tasks, deadlines, and a learning environment that conveys the idea of the school structure; and (d) give students appropriate feedback. This way, students can maintain their academic motivation by having a more concrete idea of current and future expectations. For teachers, this is certainly a great challenge, as they are asked to promote students' motivation through distance learning that shifts away from the more traditional forms of teaching, that is, through direct in-person contact.

Teachers and parents can also play a relevant role in promoting students' participation in extracurricular activities, within the limits allowed by the restrictive measures (e.g., music lessons, drama clubs, dance practice). Prior research suggested that when encouraged to participate in extracurricular activities by a nurturing adult, students tend to put forth more effort into those activities, aiming to achieve higher

levels of success and recognition (Hanline, 2018). Therefore, teachers, through distance contact, and parents, through direct contact, may encourage and support students in participating in extracurricular activities.

Conclusion

This study provided insights into the changes in students' academic motivation and participation in extracurricular activities, as perceived by their parents, during a dramatic historical period that affected the whole world. A key priority of education institutions is to promote and ensure students' learning within a safe, supportive, and motivating environment. The spread of COVID-19 has led to new modalities of instruction to enable students to continue learning in a safe environment, which, during lockdown, was the student's home. Therefore, this exceptional situation represented an inevitable challenge that required constant adaptation by teachers, students, and their parents. Despite the efforts of teachers and parents to mitigate the effects of the COVID-19 restrictive measures on students, our results showed a decrease in students' academic motivation associated with a decrease in their participation in extracurricular activities.

In light of possible future exceptional situations, teachers and parents could combine their efforts to fulfill students' psychological needs for competence, autonomy, and relatedness, thereby fostering their motivation. Moreover, they may encourage students' participation in extracurricular activities to achieve a good balance between academic and extracurricular activities, acting as a buffer for academic motivation.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethical Committee for the Psychological Research, University of Padova, Italy. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SZ performed conceptualization, methodology, writing original draft, review and editing, and project administration. AC performed conceptualization, methodology, writing original draft, and review and editing. NC performed methodology, writing original draft, and review and editing. CA performed supervision and writing review and editing. LM performed supervision and writing review and editing. RA performed supervision and writing review and editing. JD performed data analysis, writing original draft, review and editing. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2020.592670/full#supplementary-material

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The Psychological State of Teachers During the COVID-19 Crisis: The Challenge of Returning to Face-to-Face Teaching

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Schools in Spain were closed in March 2020 to prevent the spread of COVID-19. In September 2020 most schools and universities in Spain reopened and teachers felt great uncertainty due to this unprecedented situation. Teachers have accumulated psychological symptoms since the beginning of the pandemic. During the lockdown they had to introduce online teaching and in view of the reopening of schools they have shown great concern for the new unprecedented teaching situation. The present study aims to measure the symptomatology shown by teaching staff in the Basque Autonomous Community at the time when schools were reopened. To do this, we recruited a sample of 1,633 teachers who were given an online questionnaire which, in addition to collecting socio-demographic data, measured stress, anxiety and depression using the DASS-21scale. The results revealed that a high percentage of teachers showed anxiety, depression and stress symptoms. Furthermore, variables such as gender, age, job stability, the level of education at which they teach and parental status also influence this symptomatology. We argue for the need to safeguard the mental health of teachers in order to improve both the quality of teaching and the mental health of students.

Keywords: education, teachers, stress, anxiety, depression, COVID-19

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INTRODUCTION

The COVID-19 pandemic has changed our understanding of the world as we previously knew it. The strong measures of social distancing and lockdown that have been applied since the beginning of the pandemic have led to significant changes in social relationships, which, for many people, have created feelings of isolation and loneliness (Smith and Lim, 2020).

Indeed, the rapid transmission of COVID-19 throughout the world has had health, social, psychological, economic and, of course, educational consequences. In fact, school closure has been, on a global scale, one of the most widely used measures for helping to maintain social distancing and to decrease infections (Sheikh et al., 2020; Van Lancker and Parolin, 2020; Viner et al., 2020).

In fact, the United Nations Educational, Scientific and Cultural Organization (UNESCO), 2020b estimated that at the end of March 2020, 1.574,989,812 students (90% of those enrolled) in the world were affected by the closure of schools due to COVID-19. Eight months later, with the beginning of the 2020–2021 school year, there were still 851,870,246 students in the world affected by school closures (48.7% of those enrolled).

In the Basque Country, a territory in the north of Spain, the first restrictive measure that was implemented in response to the COVID-19 pandemic was the closure of all education centers. And on March 12, 2020, the Basque Government closed all schools and universities (Basque Government Health Department, 2020). Two days later, on March 14, the Spanish Government declared a state of emergency, extending this restriction to the whole country (Gobierno de España, 2020b). From that moment, a strict lockdown began, and Spanish children and adolescents were confined to their homes for more than 6 weeks (Idoiaga et al., 2020a,b), after which a de-escalation phase began in which the restrictions were gradually eased until the beginning of July (Gobierno de España, 2020a). Therefore, school and university teaching were transformed overnight into a virtual modality and remained this way throughout the 2019–2020 academic year (Al Lily et al., 2020; Besser et al., 2020; Kim and Asbury, 2020).

The Response of Teachers to the Pandemic

The pandemic has not only affected the mental state of students (Cachón-Zagalaz et al., 2020), since teachers have also accumulated a high level of stress since the beginning of the crisis. Recent studies have pointed out that during lockdown, teachers have suffered stress from having to adapt (in record time) in order to provide online classes (Besser et al., 2020). This stress has often been accompanied by symptoms of anxiety, depression, and sleep disturbance as a consecuence of the increased workload resulting from home teachi Ng (2007).

Not many studies conducted during the pandemic measure the symptoms of stress, anxiety, and depression among teachers but the studies that have been carried out suggest that they have psychological symptoms and this reinforces the importance of reopening schools and universities. A recent Arab study has indicated that this crisis has caused teachers to suffer problems that are often related to a pandemic situation, such as anxiety, depression, domestic violence, and divorce, all of which restrict their ability to teach properly (Al Lily et al., 2020). A study carried out in three cities in China during the pandemic assessed the prevalence of anxiety among teachers and found a prevalence of 13.67%, with women being more anxious than men and the older ones being more symptomatic (Li et al., 2020). Another study conducted in March also in China showed that the prevalence of stress symptoms in teachers was 9.1% and that it was important to support them psychologically (Zhou and Yao, 2020). In a study conducted in Spain at the beginning of the panemic, teachers also reported having workloads, psychosomatic problems, and exhaustion (Prado-Gascó et al., 2020).

Moreover, previous studies have found that working from home using Information and Communication Technologies (ICT) can create feelings of tension, anxiety, exhaustion, and decreased job satisfaction (Cuervo et al., 2018), and in times of a pandemic these were the only tools that were available to teachers.

United Nations Educational, Scientific and Cultural Organization (UNESCO) (2020a) has already identified confusion and stress among teachers as being one of the adverse consequences of school closures, due to the abruptness of such measures, uncertainty about their duration, and a lack of familiarity with distance education. The unpleasant work-related emotions associated with the depletion of psychological resources has long been a topic of frequent discussion among education professionals, policy makers, and researchers (Kim and Asbury, 2020). This may occur because the long-term nature of the problem leads to exhaustion by creating less confidence in their ability to do their jobs and makes it more difficult to manage student behavior (Burić and Kim, 2020).

To this new context, it should be added that the teaching profession has always brought with it added stress due to excessive workloads, interpersonal communication problems, insufficient training, and job insecurity (Pérez, 2003). Research carried out in several countries has revealed that in the teaching profession there have been many casualties of stress, anxiety, and depression (Ryan et al., 2017; Von der Embse et al., 2019). In fact, psychological symptomatology has been studied in both primary (Extremera et al., 2010; Skaalvik and Skaalvik, 2016; Abdullah and Ismail, 2019) and secondary (Betoret, 2006, 2009) educators as well as in university teachers (Malik et al., 2017; Puertas-Molero et al., 2018). Although more psychological symptomatology has been detected in secondary school educators (Arias et al., 2019), in comparison with those working in primary schools, other variables such as salary, relationships with students, and relationships with classmates are also important factors (Prieto and Bermejo, 2006). This stress may have consequences for the health of teachers and, as a result, coud lead to increased instances of sick leave, absenteeism, and poor work performance (Moreno et al., 2004). Further, it is important to safeguard the emotional health of teachers since, as a recent study by De la Fuente et al. (2020) highlights, teacher–student relationships are also stressors for the student, and the teacher's behavior predicts the emotional well-being and commitment of the students, which are also important factors for reducing their stress levels.

Another issue worthy of consideration is the fact that the COVID-19 pandemic has not only created a health crisis but also an extremely significant global economic downturn, the effects of which have been particularly harsh in Spain (Torres and Fernández, 2020). In fact, the job instability of teachers was an issue that had already attracted attention before the pandemic (García and Martín, 2012) and COVID-19 has only served to exacerbate this problem with more layoffs and instability (Aunión and Romero, 2020; La Vanguardia., 2020). Several investigations analyzing the impact of job instability on teachers have shown that this can have significant psychological consequences (Leibovich, and de Figueroa, 2006).

Amid this context of uncertainty, the 2020–2021 academic year has approached without any clear decision on how it

will be played out (Zafra, 2020). In fact, since the end of August, families, students, teachers and educational centers have been expressing their concerns about the uncertainty surrounding the new academic year and the lack of clear guidelines from the government (Rioja, 2020). On August 27, the Spanish Government and the Autonomous Communities at the Education Sector Conference agreed on the main measures that would be adopted for a return to the classroom (Sanchez, 2020). On August 28, the Basque government's civil protection monitoring commission reported on the measures to be taken in the new 2020–2021 year (Basque Government Health Department, 2020). However, the way in which these measures could be implemented with the resources available to the schools emerged as a considerable challenge and source of concern only one week before the beginning of the school year on September 7 (Lucas, 2020).

Whilst classes reopened in September, teachers and education centers were not satisfied with the guidelines that they were required to follow. Moreover, responsibility for the health measures was in the hands of each individual school, high school, and university (Zafra, 2020). As a consequence of this situation, and in view of the sense of unease that it created, a strike of non-university teachers was called and carried out on September 15 in the Autonomous Community of the Basque Country, with approximately 50–70% of teachers participating in this action (Navarro, 2020).

Aims and Hypothesis

Work conducted within academia suggests that the immediate priority of the research community during this unprecedented time should be to reduce mental health problems and support the well-being of vulnerable groups. The COVID-19 pandemic could have a long-lasting impact on teachers and teaching activities and, as a consequence, on children and adolescents (Holmes et al., 2020).

By considering how teachers are coping with the return to school during this pandemic we might be in a better position to put in place the relevant support structures that may be needed (Dalton et al., 2020; Holmes et al., 2020; Wang et al., 2020). Therefore, the impact of the COVID-19 pandemic on the emotional well-being of teachers is a major challenge that needs to be tackled by both the educational community and society in general. Although amid this pandemic we have already witnessed rising levels of symptomatology in society as a whole and in members of certain professions such as the healthcare sector (Chen et al., 2020; Dosil et al., 2020), this reality has not yet been studied among teaching staff in Spain. Thus, the main objective of this study is to evaluate the emotional state of teachers at a critical moment in the current crisis, that is, during the reopening of schools and educational centers of the Basque Autonomous Community following a six-month hiatus to prevent the transmission of COVID-19.

In particular, we aimed to analyze the levels of depression, anxiety, and stress that have been experienced by teachers at the beginning of the 2020–2021 school year and how this symptomatology was affected by the sector in which they work (pre-school, primary, secondary, vocational, or university education) along with their job stability. Differences in symptoms will also be analyzed according to gender, age and whether they had school-age children who were also facing a return to school. In addition, it was also analyzed if being infected with COVID-19 or lockdowned at the time of answering the questionnaire or if someone close to them had been sick with COVID-19 affected the teachers' answers.

We expected to observe high levels of symptomatology, with women, younger people, and those with children being most affected. It was also anticipated that the people with the greatest instability in the workplace will be those who display the most symptoms, and that secondary school teachers will be the ones who experience the greatest degree of psychological discomfort.

MATERIALS AND METHODS

Participants

This study was carried out with a total sample of 1,633 teachers from compulsory and non-compulsory education (from nursery education to university studies) from the various education centers (public and private) of the Basque Autonomous Community and Navarre (Spain). Of the sample, 79.7% were women (n = 1293), and 20.3% were men (n = 330), with an average age of 42.6 years (SD = 9.96). In terms of sector, 18.9% were teaching in Pre-school Education (n = 309), 32.55% in Primary Education (n = 530), 30.1% in Secondary Education (n = 491), 5.5% Bachelor Studies (n = 89), 5.6% Vocational Training (n = 91), and 7.5% were teaching University Studies (n = 123).

Measures and Instruments

A questionnaire was designed to gather socio-demographic data (gender and age), whether they were infected with COVID-19 or lockdowned whether someone close to them had been sick with COVID-19, information on parental status, and questions about the duration of their employment contract along with the sector in which they are teaching.

The Spanish version of the Depression Anxiety and Stress Scale-21 [DASS-21, Ruiz et al., 2017] was employed. This instrument consists of 21 items with 4 response options (from 0 = did not occur to 3 = occurred a lot or most of the time) that are grouped into three factors: depression, anxiety, and stress: Depression (items: 3, 5, 10, 13, 16, 17, and 21), Anxiety (items: 2, 4, 7, 9, 15, 19, and 20), and Stress (items: 1, 6, 8, 11, 12, 14, and 18). For the study, cut-off points were used: no symptoms, mild, moderate, severe and extremely severe symptoms. Regarding the reliability of the scale, the Cronbach's alpha coefficient was $\alpha = 0.76$ for the depression scale, $\alpha = 0.82$ for the anxiety scale, and $\alpha = 0.75$ for the stress scale.

Procedure

The study was approved by the Ethics Committee of the UPV/EHU (code M10/2020/070). The initial contact was made through e-mail and the answers were collected through an online questionnaire between September 5 and 28, 2020 (beginning of the school year). A total of 1658 people participated in the study;

however, 25 questionnaires had to be withdrawn because they had more than 50% of the answers blank. For the collection of the data, all the requirements established by the Organic Law 15/99 of Personal Data Protection were followed, that is, all the participants gave their approval before the beginning of the questionnaire.

Likewise, before beginning the questionnaire that measures the different symptoms (previously used in a Spanish sample because of its reliability in the joint analysis of the three symptoms) the participants have at their disposal a series of instructions from the questionnaire (description of the sample, specifically the Likert type responses of the questionnaire, as well as its objective).

Data Analysis

The data were analyzed using the statistical program IBM SPSS Statistics for Windows, Version 26.0 (Armonk, NY, United States). Two assumptions of normality and homogeneity of variations were then demonstrated prior to conducting the corresponding analysis to decide whether parametric or non-parametric tests were used. Specifically, the critical level of $p < 0.05$ of the Kolmogorov–Smirnov statistic was analyzed to determine the distribution of the data for the analysis of group differences.

Depression, anxiety and stress were categorized using the cut-off scores of the instrument to establish the different levels (mild, moderate, severe, and extremely severe). First, both the frequencies and the percentages of the socio-demographic variables were described, after which a series of tests were carried out. On the one hand, *t*-student was carried out for variables with two groups and an ANOVA was carried out in order to observe the differences of the dependent variables in the case of having an independent variable in three groups (age, work stability, and teaching subject). For the difference between the groups, Bonferroni's tests between groups were used.

RESULTS

Table 1 shows the prevalence data for teachers suffering from depression, anxiety and stress.

Of the sample, 50.6% of the teachers indicated that they were suffering from stress, with 4.5% reporting extremely severe stress and 14.1% severe stress. About 49.5% of the teachers reported suffering from anxiety, 8.1% of which reported extremely severe symptoms and 7.6% severe symptoms. Finally, 32.2% of the teachers reported suffering from depression, of which 3.2% reported extremely severe symptoms and 4.3% severe symptoms.

Comparison tests were conducted using *t*-student and ANOVAs to explore whether gender, age, being infected or locked up, infection of close relatives, parental status, length of contract, and education sector were related to levels of depression, anxiety, and stress Of all these variables the ones that were not significant were to be infected with COVID-19 or lockdowned and to have a close relative who had been sick with COVID-19. The following **Tables 2–4** show the descriptive statistics of the significant variables and relations that were statistically significant.

TABLE 1 | Frequency and percentages of teachers that suffer from depression, anxiety, and stress.

		n (%)
Depression	None	1107(67.8)
	Mild	208(12.7)
	Moderate	195(11.9)
	Severe	70(4.3)
	Extremely severe	53(3.2)
Anxiety	None	825(50.5)
	Mild	200(12.2)
	Moderate	351(21.5)
	Severe	124(7.6)
	Extremely severe	133(8.1)
Stress	None	806(49.4)
	Mild	263(16.1)
	Moderate	260(15.9)
	Severe	230(14.1)
	Extremely severe	74(4.5)

The data in **Tables 3**, **4** indicate that gender differences emerged with regard to anxiety [t (1,621) = 4.65, $p > 0.001$] and stress [t (1,621) = 3.94, $p > 0.001$] with women showing higher scores on anxiety ($M = 4.28$) and stress ($M = 8.09$) versus men's anxiety ($M = 3.26$) and stress ($M = 6.96$). With regard to age, differences were found for anxiety [F (2, 1,629) = 5.50, $p = 0.004$, $\eta^2 = 0.117$] and stress [F (2, 1,629) = 4.77, $p = 0.009$, $\eta^2 = 0.109$]. In particular, older participants (>47 years) showed greater levels of anxiety ($M = 8.35$) and stress ($M = 7.69$), whilst the younger participants (23–35 years) showed higher stress scores ($M = 7.52$) than those aged between 36 and 46 years.

Differences also emerged according to whether or not the participants have school-aged children, with those having school-aged children showing higher levels of stress [F (3, 1,612) = 2.68, $p = 0.046$, $\eta^2 = 0.081$], although the effect size was small.

Finally, with regard to employment stability, those with an employment contract of less than 3 months showed the highest scores on depression [F (3, 1,629) = 23.53, $p = 0.014$, $\eta^2 = 0.241$], anxiety (F (3, 1629) = 3.43, $p = 0.016$, $\eta^2 = 0.092$] and stress [F (3, 1,629) = 2.64, $p = 0.048$, $\eta^2 = 0.081$]. Likewise, differences emerged with regard to teaching sector [F (5, 1,627) = 4.55, $p = 0.001$, $\eta^2 = 0.106$] with primary and secondary school teachers showing higher scores on anxiety compared with those teaching in the university sector.

DISCUSSION

The results of this study have confirmed that a high percentage of teachers suffered from symptoms of anxiety, stress and depression when the schools and universities reopened. These symptomatology rates are somewhat high in comparison with those reported in another study conducted during the pandemic with the general population in the same area of Spain (Ozamiz-Etxebarria et al., 2020). Nonetheless, these findings are in line with those of other studies carried out from the beginning of the

TABLE 2 | Means, standard deviations and group differences for depression according to gender, age, parental status, work stability, and teaching sector.

			Depression				
Gender	***M***	***SD***	***n***	***t***	***df***	***p***	
Female	3.77	4.04	1293	1.34	1629	0.660	
Male	3.66	4.02	330				
Age	***M***	***SD***	***n***	***F***	***df***	***p***	***Post hoc***
23–35years (1)	3.52	3.97	451	1.63	2	0.196	
36–46 years (2)	3.71	3.84	578				
47 years or older (3)	7.52	4.58	451				
Children	***M***	***SD***	***n***	***t***	***df***	***p***	
Yes	3.66	4.04	772	0.049	1631	0.825	
No	3.83	4.02	861				
Work stability	***M***	***SD***	***n***	***F***	***df***	***p***	***Post hoc***
Less than 3 months (1)	5.42	5.91	54	3.53	3	0.014**	1 > 2,3,4
Between three months and one year (2)	3.33	3.75	102				
One year and more (3)	3.67	3.87	503				
Indef (4)	3.74	3.99	974				
Teaching subject	***M***	***SD***	***n***	***F***	***df***	***p***	***Post hoc***
Pre-school Education (1)	3.62	4.04	309	0.350	5	0.882	
Primary Education (2)	3.68	3.89	530				
Secondary Education (3)	3.81	4.01	491				
Bachelor (4)	3.61	4.07	89				
University studies (5)	3.93	3.97	123				
Vocational training (6)	4.14	4.90	91				

***p < 0.01.*

TABLE 3 | Means, standard deviations and group differences for anxiety according to gender, age, parental status, work stability, and teaching sector.

			Anxiety				
Gender	***M***	***SD***	***n***	***t***	***df***	***p***	
Female	4.28	3.59	1293	3.92	1629	0.001***	
Male	3.26	3.31	330				
Age	***M***	***SD***	***n***	***F***	***df***	***p***	***Post hoc***
23–35years (1)	4.29	3.78	451	5.50	2	0.004**	1 < 2,3, 2 < 3,
36–46 years (2)	4.33	3.38	578				
47 years or older (3)	8.35	4.62	578				
Children	***M***	***SD***	***n***	***t***	***df***	***p***	
Yes	4.05	3.60	772	0.049	1631	0.825	
No	4.13	3.55	861				
Work stability	***M***	***SD***	***n***	***F***	***df***	***p***	***Post hoc***
Less than 3 months (1)	5.48	4.45	5.48	3.43	3	0.016***	1 > 2,3,4
Between three months and one year (2)	3.76	3.24	102				
One year and more (3)	4.20	3.73	503				
Indef (4)	3.99	3.45	974				
Teaching subject	***M***	***SD***	***n***	***F***	***df***	***p***	***Post hoc***
Pre-school Education (1)	4.35	3.72	309	4.55	5	0.001***	1 > 5 2 > 5
Primary Education (2)	4.45	3.58	530				
Secondary Education (3)	3.95	3.50	491				
Bachelor (4)	3.95	3.50	491				
University studies (5)	2.95	3.00	123				
Vocational training (6)	3.86	4.01	91				

**p < 0.05; **p < 0.01 and ***p < 0.001.*

TABLE 4 | Means, standard deviations and group differences for stress according to gender, age, parental status, work stability, and teaching sector.

			Stress				
Gender	***M***	**SD**	***n***	***t***	***df***	***p***	
Female	8.09	4.58	1293	3.28	1629	0.001***	
Male	6.96	4.89	330				
Age	***M***	SD	***n***	***F***	***df***	***p***	***Post hoc***
23–35years (1)	7.69	4.58	451	4.77	2	0.009**	1 > 2,3 2 < 3
36–46 years (2)	3.71	3.57	603				
47 years or older(3)	7.52	4.75	603				
Children	***M***	SD	***n***	***t***	***df***	***p***	
Yes	8.10	4.80	772	3.99	1631	0.046*	
No	7.67	4.54	861				
Work stability	***M***	SD	***n***	***F***	***df***	***p***	***Post hoc***
Less than 3 months (1)	8.64	5.52	54	2.64	3	0.048*	1 > 2,3,4
Between three months and one year (2)	6.88	4.49	102				
One year and more (3)	7.69	4.79	503				
Indef (4)	8.03	4.56	974				
Teaching subject	***M***	SD	***n***	***F***	***df***	***p***	***Post hoc***
Pre-school Education (1)	7.77	4.73	309	5.24	5	0.943	
Primary Education (2)	7.91	4.42	530				
Secondary Education (3)	7.91	4.42	530				
Bachelor (4)	7.48	4.74	89				
University studies (5)	8.04	4.57	123				
Vocational training (6)	7.73	5.48	91				

*$p < 0.05$; **$p < 0.01$ and ***$p < 0.001$.

pandemic showing that during lockdown, teachers have suffered from stress (Besser et al., 2020), anxiety (Huang and Zhao, 2020), and other psychological and physical symptoms (United Nations Educational, Scientific and Cultural Organization (UNESCO), 2020b; Aperribai et al., 2020). However, this study shows that this symptomatology is not only characteristic of periods of lockdown. In fact, in this study no significant differences were found between teachers who were confined and those who were not.

Among the psychological symptoms evaluated here, the most striking findings to emerge are those related to stress. Whilst it is true that according to some studies, stress levels were already high among teachers before the onset of the pandemic (Hadi et al., 2009; Teles et al., 2020), the results of this study reveal that the levels of symptomatology are considerably higher than those the teachers could have suffered prior to the pandemic, showing that more than half of them have suffered from stress, with 18.6% of these cases being severe or extremely severe. These high rates of symptomatology among teachers could be due to the academic context in which they work and the new measures they have had to adopt without the necessary support in the form of material and human resources (Navarro, 2020). However, it should be borne in mind that this level of stress could also be linked to uncertainty about the possibility of children becoming infected in schools. In other words, since the beginning of the pandemic it has been suggested that schools could be a major source of the disease (Soriano, 2020), and although recent studies suggest otherwise (Zafra, 2020), the possibility of schools becoming a focus of the disease could also contribute toward the increase in stress levels. Therefore, returning to the classroom beyond being a return to normality seems to have become a new focus of uncertainty for teachers.

Also in this study several factors have been found that directly affect that symptomatology. Some of them are personal and others professional. Starting with the personal factors in terms of gender, this study indicates that there are higher levels of stress and anxiety among women in comparison with men. Pre-pandemic studies in the general population have already indicated that women are at significantly greater risk of suffering from symptoms of anxiety and stress (Arenas and Puigcerver, 2009; Soffer, 2010). During the pandemic, studies conducted with health professionals (Dosil et al., 2020; Huang et al., 2020; Rajkumar, 2020) and the general population (Liu et al., 2020) have continued to show this trend of greater symptomatology in women than in men. This factor, although personal, is also characteristic of the profession since most of the teachers in Spain are women; in fact 79.7% of the participants in this study were women. Therefore, it should be reflected whether in such a feminized profession might be especially susceptible to the pandemic. Some studies already point out that the role of caregiver (both professionally and personally) could also increase this symptomatology detected here (Dosil et al., 2020).

In a similar vein, the results show that having school-aged children also creates a greater impact on the feelings of stress. Having to deal with a heavy workload, combined with the stress of carrying out family care duties, may be one of the reasons why teachers with children have suffered from higher levels of stress. It should also be noted that these professionals had to face

a double return to school – both their own and that of their children. Indeed, having a family may have played a role in the increased stress experienced during the pandemic (Fitzpatrick et al., 2020), since managing a family in such times of crisis may bring with it different stresses, such as financial worries, or the additional burdens of parenting, childcare, or the demands of home schooling (Daks et al., 2020).

In terms of age, it is noteworthy that people over 47 years old are those who reported the highest levels of anxiety and stress, given that in other studies it is young people who have shown more symptoms (Picaza et al., 2020). This could be due to the fact that among teachers there are more symptoms of stress and anxiety that are the result of higher burnout (Corbin et al., 2019) and it could be the case that older people are currently feeling this symptomatology to a greater degree. Moreover, in this new situation that requires adaptability to all new technologies, younger people may have fewer difficulties whereas older people may be less interested in ICT (Song and Chen, 2019). This factor also goes partly beyond the personal since the aging of the teaching staff is a reality in Spain. Therefore, it has to be taken into account when designing coping strategies for the pandemic.

On the other hand the higher levels of stress among young people (23–35 years), compared with those aged 36–46 years is in line with the general trend observed in other studies, that is, younger people experience higher levels of stress (Lai et al., 2020). This may also be closely linked to job insecurity, a factor that has not been analyzed in the pandemic so far and that may be relevant due to the great adjacent economic crisis it is creating in countries like Spain. In fact, this study has demonstrated that those who have greater job instability show higher scores on depression, anxiety and stress. This variable can have very serious implications since it was demonstrated even before the pandemic that teachers with unstable contracts showed poorer health (both physical and mental) in spite of being young (Cladellas-Pros et al., 2018). Therefore increased job instability due to the pandemic will also be a factor negatively impacting the health of teachers and therefore urgent steps should be taken to stabilize contracts.

Furthermore, teachers working in the earlier stages of pre-school and primary education are those who showed the highest scores on anxiety. This marks a clear difference with previous studies in non-pandemic situation where high school teachers were the most affected by psychological symptoms (Arias et al., 2019). This could be due to the fact that (among other things) these teachers feel a greater responsibility for the younger children that need more care and protection because of their age, and they may feel very pressured to carry out these duties of care adequately by responding to the needs of the children and the concerns of their families. Moreover, stricter measures are being taken with younger students including "bubble" classes where students in one class cannot interact with other classes, whereas secondary school and university students are more autonomous and do not require as much care from teachers. Therefore, a system of educational reinforcement to be able to carry out all the tasks that are demanded of them would be convenient to reduce this psychological discomfort.

Until now, no studies in Spain have analyzed the psychological impact of the return to schools on teachers during a pandemic, and this is the main strength of this study. Moreover, our findings could have relevant practical implications. First, it would be highly desirable to decrease the psychological impact on teaching professionals (particularly women, older teachers, those with less job security, and those who have children in their care). To this end, it would be beneficial to provide psychological support through telephone or face-to-face assistance. Further, it would be helpful to create more optimal communication channels for gathering information about COVID-19 and its implications for schools. In fact, the lack of clarity with regard to appropriate guidelines along with the scarce resources available has posed a great challenge and is a problem that needs to be urgently addressed within the entire school community (Lucas, 2020).

Regarding the limitations of the study, the generalizability of our results is limited, since we used a non-probabilistic sample. In particular, there may be a certain selection bias, since participation was voluntary, and therefore only those who were particularly emotionally affected could have participated. Furthermore, the cross-sectional nature of the study does not allow a comparison between pre-pandemic and post-pandemic results. Moreover, variables related to the impact of the pandemic have not been taken into account such as whether people close to them had died from COVID-19 or whether they lived in areas with a particular constraint. Future studies should use a more extensive sample, including participants from more autonomous communities. They should also take into account more variables related to the direct impact of the pandemic.

CONCLUSION

Members of the teaching profession experienced psychological discomfort at the beginning of the new 2020–2021 academic year. This symptomatology has been found to be higher in women than in men, but, contrary to our expectations, was found be higher in older people and in teachers of infant and primary education. As expected, people with job instability are those who have suffered the most psychological symptoms. These findings indicate the importance of safeguarding the mental health of teachers to ensure both the well-being of students and high quality teaching. Therefore, special psychological care should be given to those teachers that are most vulnerable to the impact of this pandemic, so that they could better cope with this crisis, and consequently perform better in their teaching role. In short, we must bear in mind that the education received by young people in this current time of crisis will shape the society of the future. Therefore, if we want this education to be of a high standard, then we must protect the psychological well-being of the people who provide it.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee for Research Related to Human Beings (CEISH) of the UPV/EHU. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

NI and NO-E were involved in the conceptualization of the project and in the acquisition of the data. NB and MD were involved in the analysis and interpretation of the data. All authors were involved in the drafting and revising of the work for intellectual content, provided approval for submission of the contents for publication, and agreed to be accountable for the accuracy and integrity of the project.

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State-Anxiety and Academic Burnout Regarding University Access Selective Examinations in Spain During and After the COVID-19 Lockdown

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Coping with assessment tests are known to generate anxiety frequently in the students who face them. In academic circumstances with the continued presence of emotional disturbance, high demand, and stress, emotional and physical fatigue, typical of burnout syndrome, and can be detected. Anxiety and burnout are related to each other and even more closely in high-stakes tests. One of these tests is the examination imposed in Spain for access to the university. The objective of this work is to analyze the presence of anxiety and burnout and the relationship between them in students who face these tests, both during the confinement situation due to the COVID-19 pandemic and during the pandemic after the lockdown. For this purpose, we used a sample of 1,021 students with a mean age of 17.89 (SD = 1.22, range 17–27). Of these, 866 (84.8%) were students who were taking the test, while the rest were university students who had passed it recently. Our results show high levels of anxiety and burnout in students who face the evaluation test during the COVID-19 pandemic, sustained over time and especially in comparison with students who had already taken the exam. The association between higher levels of anxiety and higher levels of burnout in the students who take these exams was also verified. These results link the relationship between these two variables more solidly and suggest the need to include address anxiety to reduce burnout levels in these students. The results are discussed with regard to prior evidence and their applications.

Keywords: anxiety, test-anxiety, burnout, university access, evaluation, educational psychology, health emergency, COVID-19

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INTRODUCTION

Given the escalation in the number of COVID-19 infections at the beginning of March 2020 in Spain, the government of the nation, after the convocation of an extraordinary council, declared a state of alarm on March 14 of that year (Royal Decree 462/2020., 2020). This declaration came just 3 days after the World Health Organization raised the public health emergency caused by COVID-19 to an international pandemic on March 11, 2020 (World Health Organization, 2020).

The main decision derived from that declaration by the Spanish government was the imposition of a national quarantine. The measure came into force at 00:00 h on Sunday, March 15, and implied forced isolation of all Spanish citizens and foreigners residing in Spain (Jones, 2020; Royal Decree 462/2020., 2020).

On April 28, the government announced the so-called the "Deconfinement Plan," consisting of four phases that concluded in the "new normality" on June 21, thus ending the state of alarm at 00: 00 h of that day (Sánchez and Álvarez, 2020). During that period of the state of alarm (and afterward, until September 2020), the educational system ceased working in person, teaching exclusively online. This operation affected various areas, with final-year high school students being particularly affected, especially because preparation for the selective university entrance exams takes place during this course. This year, the tests for the June call were delayed to ensure better health security conditions and were carried out, in person, in the first half of July (Yaq.es., 2020). Preparation for the tests in these circumstances was clearly not the same as that of previous courses, depending fundamentally on the students' individual work at home and in isolation. It should be clarified that in Spain, as in other countries, university entrance exams are the access route to public universities. Likewise, the choice of career depends almost directly on the note obtained in them.

Some studies have already shown how the confinement situation in different countries has been associated with anxiety, mood changes, changes in daily life patterns (including increased consumption of tobacco and alcohol, longer exposure to screens, etc.) and worsening health-related behaviors, among other variables (Alemany-Arrebola et al., 2020; López-Bueno et al., 2020a,b; Smith et al., 2020).

Getting tired of performing activities continuously is normal. When these activities are inherent to work or responsibility and are carried out for long periods of time (i.e., years), they can lead to chronic fatigue, popularly referred to as being "burnt." In Psychology, for a long time, this state has been called burnout and has been conceptualized as a state of emotional, physical, and cognitive exhaustion as a consequence of performing responsible activities under demand and stress (Barraza, 2011). Burnout is classically characterized by three sets of manifestations: (a) fatigue, which is the main manifestation; (b) depersonalization and distancing from the required performance, with manifestations such as low achievement and abandonment; and (c) loss of commitment and decrease in personal achievement and motivation (Maslach and Jackson, 1986; Rodríguez-García et al., 2017). Although at first, burnout was detected and studied in work and professional contexts, its study was soon extended to the educational context. In this area, it was observed that burnout could be associated with lower levels of academic achievement and performance, and low self-efficacy and motivation, among other aspects (Rahmati, 2015; Fiorilli et al., 2017). In students, stress and overload over an extended time have been considered etiological factors that explain the presence of exhaustion and lack of motivation (Yang, 2004), and, like in professional performance, absenteeism, dropout and low satisfaction with studies (Rahmati, 2015; Fiorilli et al., 2017; Salmela-Aro and Read, 2017). In the educational context, one of the circumstances that generates more demand and continued stress in the students is the exams. Coping with exams has also been associated with students' burnout and emotional exhaustion (Yildirim, 2007; Fernández-Castillo et al., 2020), anxiety (Fernández-Castillo et al., 2009) and, possibly, great concern.

Worrying about things of daily life is normal. However, worrying excessively and continuously or without justified cause is one of the most commonly recognized symptoms of anxiety or any of its associated disorders (American Psychiatric Association., 2014; National Institute of Mental Health., 2020). Anxiety as a personality trait and anxiety as a reaction to situations that could generate it have been differentiated for a long time (Spielberger et al., 2002). Anxiety disorders are among the most frequent worldwide, affecting more than 260 million people (World Health Organization, 2017).

In the educational context, anxiety is usually present at different times and situations, with evaluation tests being one of the most frequently associated situations (Fernandez-Castillo and Caurcel, 2019). In fact, according to some authors, exam anxiety is the most common type of anxiety in the educational setting (Brodersen, 2017; von der Embse et al., 2018).

Concerning exams, anxiety is understood as a state and is characterized by a feeling of fear and tension, worry, and a perception of threat, together with negative physiological manifestations (American Psychiatric Association., 2013), moreover, with some particular characteristics such as the fear of being negatively evaluated and of failing (Fernández-Castillo, 2013). It is a transitory state, activated by anticipation or exposure to an exam, which involves the described emotional disturbance (Spielberger et al., 2002).

Exam anxiety has been associated with other psychological disorders and problems, including generalized anxiety, attention deficit hyperactivity disorder, phobias, or depression, among others (Kavakci et al., 2011; Leadbeater et al., 2012; Jacobson and Newman, 2017).

Regarding academic functioning, exam anxiety has been related to many different negative aspects that can affect the result of the exam itself or performance in general (Fernández-Castillo and Gutiérrez-Rojas, 2009; von der Embse and Witmer, 2014; Dominguez-Lara et al., 2017), as well as increased risk of academic dropout (Esch et al., 2014) or difficulties in cognitive processes such as concentration and selective attention during the examination processes themselves (Fernández-Castillo and Caurcel, 2015). Some studies have also related anxiety to the presence of burnout in students (Chust-Hernández et al., 2019).

One aspect that seems to increase exam anxiety is its possible consequences. As these are perceived by students as very important or threatening, anxiety levels may be higher, with high-stakes tests being especially anxiogenic (Segool et al., 2013). The university access exam is one of the most important tests for students in many countries. This test not only allows access to higher education, but also career choice, and even professional performance in one's life. Consequently, very high levels of anxiety have been detected during these tests in various countries (Yildirim, 2007; Kavakci et al., 2014; Unalan et al., 2017). In Spain, as in other countries, coping with these tests has been associated with burnout, poor performance, and emotional fatigue (Yildirim, 2007; Johnston et al., 2016; Fernández-Castillo et al., 2020). However, to date, we lack sufficient information about these circumstances.

Therefore, although the physical and emotional fatigue inherent to burnout and its association with anxiety during exams

have been previously studied, not many studies have studied these aspects in subjects who face the university access exam in Spain. Still less attention was paid to the extraordinary situation of confinement suffered by these students between March and June 2020, when they were not attending the educational centers in-person to prepare this test.

Consequently, in this work, we propose the following objectives. Firstly, we analyzed the levels of anxiety and burnout in the participants. Secondly, we explored the association between anxiety and burnout in students who take the university access exam after having been recently confined.

Our third objective focuses on the evolution of anxiety and burnout sustained over time, as well as the levels in confined subjects compared with a control group. Finally, our fourth objective was to analyze possible differences in burnout according to different levels of anxiety in the students who take the access exam in a post-lockdown situation.

The reviewed previous evidence makes us hypothesize that there will be a significant association between anxiety and burnout in the students who face the test. Moreover, higher levels of burnout will be found in subjects who have higher levels of anxiety before the selectivity test. On the other hand, we expect to find that the levels of anxiety and burnout will be maintained over time, and that the levels will be higher in subjects confined by COVID-19 and those who were taking the test, compared to control subjects.

MATERIALS AND METHODS

In this research, the design used was a retrospective or ex post facto study (Sharma, 2019) with a cross-sectional design to collect data.

Sample

In this research, participants were 1,021 students with a mean age of 17.89 years (Mode = 18, SD = 1.22, range 17–27). Concerning gender, 638 were female (62.5%), 368 were male (36%), four had chosen the option "others" (0.4%), and 11 (1.1%) did not provide this information. All of them studied either in the city of Granada or in its province, in Spain.

Of them, 866 (84.8%) were enrolled in their last year of high school: 390 (38.2%) were currently (during the assessment days) taking the university access exam, and 476 (46.6%) participants had been in a situation of national confinement due to the COVID-19 pandemic at least 2 month before taking it.

The remaining students (n = 155, 15.2%) were considered a control group, with assumed normal functionality (no alteration associated with the university access exam or the pandemic) because they had already taken the exam at least 3 month before the COVID-19 pandemic and were currently first-year university students. Of these, 60 studied Early Childhood Education, and 95 studied Sociology. These three groups (before taking the exam, during the exam, and already enrolled in the career (control group) formed the three groups of subjects according to the time/situation of data collection. **Table 1** shows more descriptive data on the sample of participants.

Procedure

The data collection involved two procedures in three phases, which gave rise to the three groups of participants, making up the general sample.

The first and second data collection was carried out through an online survey (google forms) whose link was distributed to a sample of last-course high school students. For this purpose, we previously contacted the board of directors of various educational centers in the province of Granada (Spain) to request authorization and collaboration. Through them, a pool of specific professors was contacted who collaborated by distributing the request for participation and the link to the questionnaire among the students.

The request to the students was accompanied by specific information detailed below, as well as the request to sign an informed consent. Students who were preparing their access to the university responded to the survey between April 1 and 30, 2020, while those who were taking the university access exam did so between July 7 and 9 of that year (the date when the tests are held in Granada). In these cases, the survey could be completed through mobile devices or PCs.

The third set of data had been collected before the COVID-19 pandemic (between December 1 and 20, 2018) from first-year university students of the specialties of Sociology and Early Childhood Education in the faculties of Sociology and Education Sciences of the University of Granada. Authorization had been requested from the professors in whose classrooms the evaluation was carried out and the data were collected in groups.

The students who were evaluated during the university access exams were asked to fill in the questionnaire either at the end of the session of any of the tests that make up the exam or during the break in any of them, but not at the end when the exam had ended. In any case, the questionnaires were completed between July 7 and 9, 2020, either on the street or at home.

TABLE 1 | Descriptive data on the sample of participants.

		Lockdown	Post-lockdown	Pre-COVID 19 (social normality)	Total
Age [mean (SD)]		17.49 (0.63)	18 (1.16)	18.86 (1.88)	
Gender [*n* (%)]	Male	167 (35.1%)	145 (37.2%)	56 (36.1%)	368
	Female	308 (64.7%)	237 (60.8%)	93 (60%)	638
	Others		2 (0.5%)	2 (1.3%)	4
	Lost	1 (0.2%)	6 (1.5%)	4 (2.6%)	11
Total		476	390	155	1021

Before requesting their consent, participants were informed of the main objectives of the research, the anonymity of the information collected, and the voluntariness of their participation. They were also requested not to leave any item unanswered and to be sincere. The criteria established by the authors of each specific inventory were taken into account.

In this research, no personal data was collected that could allow the identification of the participants. The answers given in the questionnaires were transferred to a database for subsequent statistical analysis. Regulation (EU) 2016/679 of the European Parliament and of the Council of April 27, 2016 on the protection of natural persons with regard to the processing of personal data was followed at all times.

Instruments

The evaluation instruments were assembled in a questionnaire headed by the request to report their age and gender. Concerning gender, the participant could choose "male," "female," or "other."

The Spielberger State-Trait Anxiety Inventory (STAI), in its Spanish version (Spielberger et al., 2002), was used to assess participants' anxiety. This is one of the most valid and reliable instruments for the assessment of anxiety (Spielberger et al., 1983; Fonseca-Pedrero et al., 2012), and provides an indicator of Trait-Anxiety or State-Anxiety The State-Anxiety subscale consists of 20 items that are rated on a four-point Likert scale ranging from 0 (not at all) to 3 (very much), providing a global score ranging between 0 and 60. It also presents a scale that establishes three groups according to the general score achieved (Spielberger et al., 2002): scores above 31 are considered a high level of anxiety, values between 15 and 30 express a medium level of anxiety, and scores below 14 indicate that the level of anxiety is low. Its psychometric properties are excellent, as confirmed, for example, by the results obtained in the Kuder–Richardson-20 test (KR-20), with values between 0.90 and 0.93, or the split-half reliability test, where the State-Anxiety subscale, which is the one used in the present study, reached a value of 0.94 (Spielberger et al., 2002). In our case, this subscale also reached excellent levels of internal consistency (Cronbach alpha): $\alpha = 0.92$.

To quantify burnout in the participants, we used the one-dimensional Student Burnout Scale (Barraza, 2008, 2011) in its version adapted to the Spanish population (Fernández-Castillo et al., 2020). This scale provides a one-dimensional evaluation of academic burnout, where higher scores imply greater cognitive, emotional, and physical exhaustion in general or specific academic activities. This instrument presents 15 items that are rated on a four-point response scale ranging from 1 (never) to 4 (always), with a range of possible global scores between 15 and 60. Regarding its psychometric properties, using the split-half test (according to the Spearman-Brown formula for tests of Unequal-Length), the original studies found a reliability of 0.89. In the same study (Barraza, 2011), Cronbach's alpha reached an excellent value ($\alpha = 0.91$). In our sample, the value of Cronbach's alpha was $\alpha = 0.87$.

Data Analysis

Data analysis included descriptive and frequency analysis, correlation analysis (specifically, a Pearson bivariate correlation test), and means comparisons tests, specifically one-way ANOVA, with analysis of minimally significant difference in some cases. The analyses were carried out with the SPSS statistical software, assuming in all tests a level of significance less than 0.05.

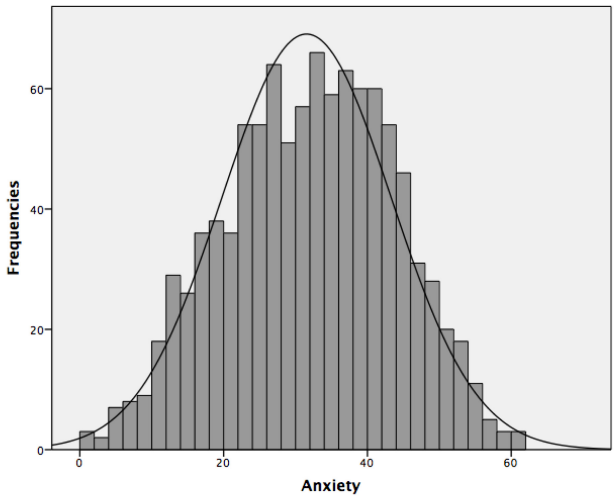

FIGURE 1 | Histogram of the distribution of anxiety in the general sample.

RESULTS

Our first objective aims to descriptively analyze the levels of anxiety and burnout in the complete sample participants. Regarding anxiety, the distribution as shown in **Figure 1** is distributed slightly above the possible medium value (30), which indicates that our participants had a medium-high level [(Mean = 31.53 (SD = 11.77)]. Regarding burnout [(Mean = 34.13 (SD = 8.04)], the distribution was grouped slightly below the central point, as can be seen in **Figure 2**.

For our second objective, we explored the association between anxiety and burnout in students who were taking the university access assessment test (post-lockdown situation). For this purpose, we only worked with this sub-group of the total sample. A Pearson bivariate correlation test was carried out ($r = 0.46$, $p = 0.00$), which clearly indicated that participants' higher levels of anxiety were significantly associated with higher levels of burnout.

Our third objective was to determine possible differences in anxiety and burnout between the three established conditions: (a) at least 2 month before the exams, when the students were confined; (b) on the days of the exam (just after lockdown, still with restrictive measures applied by the health authorities); and (c) first-year university students who had taken the exam in the past in normal social circumstances (control group). Therefore, we worked with the complete sample of study participants and carried out the respective mean comparisons (univariate ANOVA) with an additional minimal significant difference (MSD) contrast. The ANOVA indicated significant differences in anxiety between the three evaluation conditions,

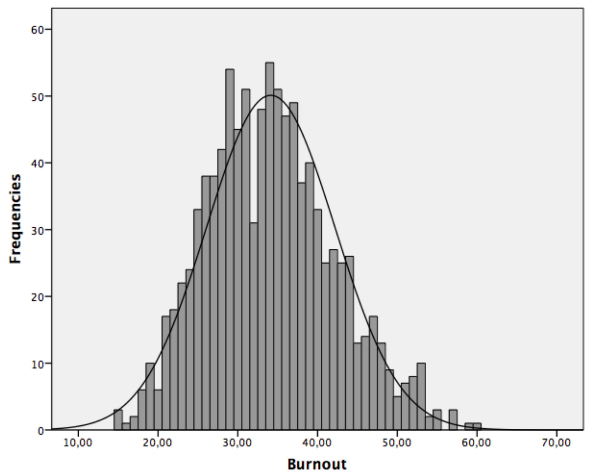

FIGURE 2 | Histogram of the distribution of burnout in the general sample.

$F(2,1016) = 74.45$, $p = 0.000$. The same relationship was also observed in burnout, $F(2,1007) = 20.03$, $p = 0.000$. The specific mean differences in burnout and anxiety between the three groups of participants are detailed in **Table 2** and **Figures 3, 4**.

Concerning anxiety, the differences were generally significant but not exactly between the three groups. The highest levels of anxiety were observed in the group evaluated at least 2 month before the access exam (whose members were in a confinement situation), but the differences between this group and the group evaluated while taking the exam were not significant. The control or normal-functional group, assessed when already enrolled in the university, presented significantly lower—almost minimal—anxiety levels.

Concerning burnout, the differences between the three groups were significant. The confined participants evaluated at least 2 month before the university access exam had higher levels than the students who were actually taking the exam, and both groups had higher levels than the control group.

Finally, the fourth objective analyzed possible differences in burnout according to different levels of anxiety in the students who took the university access exam. For this purpose, we only used the subsample of post-lockdown students who were taking the access exam at that moment, through a univariate ANOVA with an additional MSD contrast. The results indicated significant differences in burnout as a function of different levels of anxiety, $F(2,377) = 38.77$, $p = 0.000$]. The levels of anxiety were established following the scaling criteria proposed by the authors of this inventory (Spielberger et al., 2002), thus proceeding to the extraction of three groups of students according to their level in this variable. The difference in mean burnout between these three groups of participants is detailed in **Table 3** and the descriptive results are illustrated in **Figure 5**.

As can be seen in **Figure 5**, burnout levels were higher as anxiety levels rose. All comparisons between the means of these three groups of participants were significant.

DISCUSSION AND CONCLUSION

As mentioned, to date, there have been few studies about the presence of anxiety and burnout and the relationship between them in students facing the university access exam in Spain. Our study also analyses the presence of anxiety and burnout during lockdown due to the COVID-19 pandemic and in the so-called "new normality" (post-lockdown situation) in Spain.

That is why we first proposed to determine the presence of these variables in a sample of students. Our results have shown

TABLE 2 | MSD comparison of academic burnout and anxiety according to the moment of assessment.

(I) Assessment moment	(J) Assessment moment	Mean differences (I,J)	Sig.
	Anxiety		
(a) Assessment at least 2 month before the examinations (lockdown situation). (Mean = 33.92; SD = 10.84).	(b) Assessment during the evaluation test (post-lockdown situation). (Mean = 32.51; SD = 11.70).	1.41	0.06
(a) Assessment at least 2 month before the examinations (lockdown situation). (Mean = 33.92; SD = 10.84).	(c) Assessment before the COVID-19 pandemic, in first-year students (social normality situation – Control group). (Mean = 21.68; SD = 9.57).	12.24	0.00
(b) Assessment during the evaluation test (post-lockdown situation). (Mean = 32.51; SD = 11.70).	(c) Assessment before the COVID-19 pandemic, in first-year students (social normality situation – Control group). (Mean = 21.68; SD = 9.57).	10.83	0.00
	Burnout		
(a) Assessment at least 2 month before the examinations (lockdown situation). (Mean = 35.35; SD = 7.52).	(b) Assessment during the evaluation test (post-lockdown situation). (Mean = 33.97; SD = 8.54).	1.38	0.01
(a) Assessment at least 2 month before the examinations (lockdown situation). (Mean = 35.35; SD = 7.52).	(c) Assessment before the COVID-19 pandemic, in first-year students (social normality situation – Control group). (Mean = 30.73; SD = 7.34).	4.62	0.00
(b) Assessment during the evaluation test (post-lockdown situation). (Mean = 33.97; SD = 8.54).	(c) Assessment before the COVID-19 pandemic, in first-year students (social normality situation – Control group). (Mean = 30.73; SD = 7.34).	3.24	0.00

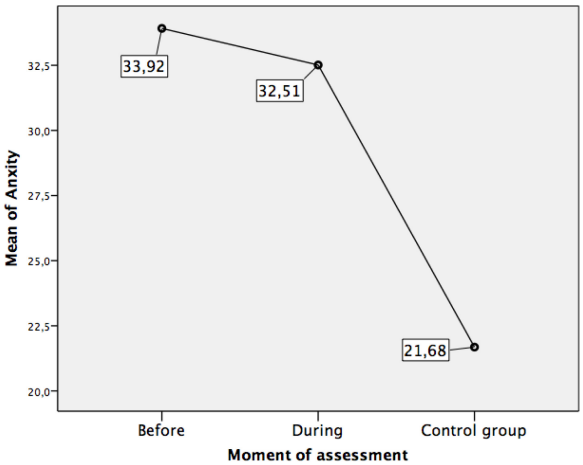

FIGURE 3 | Means in anxiety according to the assessment moment.

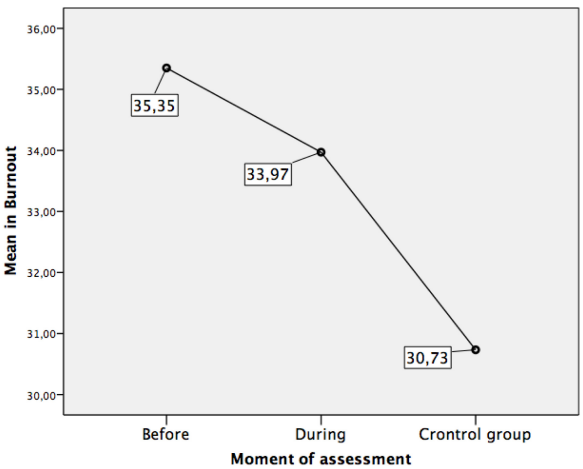

FIGURE 4 | Means in burnout according to assessment moment.

TABLE 3 | MSD comparison test in academic burnout according to anxiety levels.

(I) Anxiety level	(J) Anxiety level	Mean differences (I,J)	Sig.
Low (Mean = 25.75; SD = 6.43).	Medium (Mean = 31.03; SD = 7.62).	5.28	0.00
Low (Mean = 25.75; SD = 6.43).	High (Mean = 36.92; SD = 8.04).	11.17	0.00
Medium (Mean = 31.03; SD = 7.62).	High (Mean = 36.92; SD = 8.04).	5.89	0.00

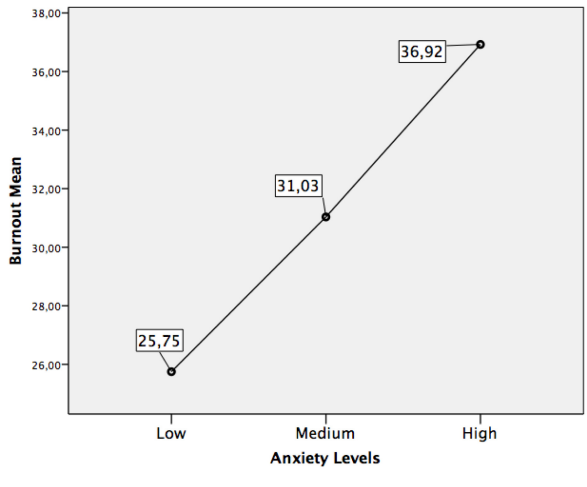

FIGURE 5 | Means in burnout according to anxiety level.

relatively high levels of anxiety and somewhat less burnout. These results agree with those found by other studies with different samples, where test anxiety is considered habitual and high (Fernández-Castillo, 2013; von der Embse et al., 2018; Fernandez-Castillo and Caurcel, 2019).

For our second objective, to determine the association between anxiety and burnout, in this case, we only analyzed the sample of students who were taking the university access exam. The significant and positive association between anxiety and burnout had been observed in students taking exams, but not in the case of the university access exam in Spain, in a national post-lockdown situation or with exceptional social interaction measures. However, these results are consistent with previous studies carried out in other circumstances (Chust-Hernández et al., 2019).

The results of our third objective were also highly interesting. We wanted to explore possible differences in anxiety and burnout between the three assessment moments or conditions: at least 2 month before the exam (lockdown), while taking the exam post-lockdown, and in students already admitted to the university (normality). The comparisons of means revealed significant differences only between the lockdown condition (months before the examination) and the control group as well as between the post-lockdown condition (on the examination days) and the control group. However, no significant differences were found between the lockdown and post-lockdown situations, indicating that the levels of anxiety were already high at least 2 month before the access exam (when students were in lockdown), and remained so until the days of the exam. Anxiety levels were significantly lower in students who were enrolled in the university. This result coincides with others that had already found very high levels of anxiety in this type of exam in other countries (Yildirim, 2007; Kavakci et al., 2014; Unalan et al., 2017). The result indicates that the exposure to anxiety is probably maintained for months (probably throughout the entire last high school course, which focuses on preparing students for the university access exam) and it possibly increased due to the lockdown when these students could not attend their educational centers in person and had to prepare the exam at home. This also indicates these students' high concern, especially due to anticipation, which may also have consequences for their psychological health. Taking these results into account, the study of the possible long-term psychological and behavioural consequences should be addressed in future studies.

The comparative analysis of the burnout means in the three groups of students also revealed significantly different levels of emotional and physical fatigue regarding their academic work. It is noteworthy that at least 2 month before the access exam (during the lockdown), participants showed an even higher level of burnout than during the days the exam was held. This result could be explained because, in the days of the exam, the end of a process that had lasted practically the entire academic year is perceived, which is liberating. As expected, the group with the lowest burnout level was the group of university students. This control group contextualizes the result of anxiety in the other two groups that face the access exam.

Finally, to delve into the relationship between anxiety and burnout, our fourth objective explored possible differences in burnout according to different levels of anxiety only in the group of students who were taking the access exam. These students faced the access exam in exceptional historical circumstances, having been confined for 2 month before the exam and surrounded by social-health measures that were also unique (including the use of a face mask, maintaining social distance, etc.). The differences in burnout between the low, medium, and high anxiety groups were significant. The relationship between higher anxiety and higher levels of burnout is clear and significant and in line with the findings of other studies in other populations (Chust-Hernández et al., 2019). These results more solidly link the relationship between these two variables during university access exam, suggesting the need to address anxiety to reduce burnout levels in these students.

To conclude, our study shows that coping with university access exams, considered high-stakes tests, generate high levels of anxiety and concern in these students, an aspect that was already studied in other samples and countries (Segool et al., 2013). Anxiety seems more intense during the lockdown due to the COVID-19 pandemic and also afterward, in the post-lockdown situation. Our results also verified that anxiety is maintained for very long periods of time, at least 2 month before the exam. Future studies could explore anxiety for even longer intervals, as well as the consequences of exposure to these circumstances. It may also be of interest to explore other aspects that may be present in this context, such as other emotional disturbances or negative effects that these exams may have on students. It is already known that greater perceived importance of an exam could be associated with a higher perception of threat and concern in those who face it. Our study is pioneer in detecting and relating these variables in these students and these academic circumstances, not only the exceptional situation derived from the COVID-19 pandemic but also the circumstance that most students who want to access the university in Spain must undergo.

A possible limitation of our study refers to the sample of participants used. Specifically, given the type of sampling carried out, the sample may not represent the reference population and therefore our results must be taken with caution in order to generalize. Despite it, our results also open a line of reflection on these aspects of our educational system, which could harm students' health. It should be kept in mind that anxiety is one of the most frequent psychological disorders worldwide (World Health Organization, 2017), and is associated with a multitude of other problems. The reduction of anxiety and burnout should be a concern, both for educators and policy-makers in this educational and evaluation area.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

AF-C conceived and designed the study, obtained the information, performed the statistical analysis, interpretation of the results, and wrote the manuscript.

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Conflict of Interest: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Consequences of COVID-19 Confinement on Anxiety, Sleep and Executive Functions of Children and Adolescents in Spain

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Children and adolescents are not indifferent to the dramatic impact of the COVID-19 pandemic, and the need to be forced to live in confinement. The change in life to which they have been abruptly subjected forces us to understand the state of their mental health in order to adequately address both their present and future needs. The present study was carried out with the intention of studying the consequences of confinement on anxiety, sleep routines and executive functioning of 1,028 children and adolescents, aged from 6 to 18 years, residing in Spain to; assess if there are differences regarding these consequences in terms of sex and age; how anxiety affects executive functioning in males and females; and to examine the possible correlations between the measured variables. For this purpose, an online questionnaire containing five sections was designed: the first section gathers information on sociodemographic and health data, while the following sections gather information from different standardized scales which measure anxiety, sleep and executive functions, whose items were adapted in order to be completed by parents, and/or legal guardians. The statistical analyzes carried out highlights significant differences in executive functioning between males and females. In turn, in regards to age, greater difficulties were detected in anxiety in the 9 to 12 age group and greater sleep disturbances between 13 and 18 year olds. On the other hand, significant differences were found in intra-sexual executive functioning depending on whether they presented greater or lesser anxiety, with executive functioning being more tendentiously maladjusted in males than in females, revealing a significantly relevant effect size ($p = 0.001$; $\omega^2 = 0.27$ BRIEF-2; $\omega^2 = 0.19$ BDEFS-CA; 95%). Positive correlations are obtained between state anxiety and sleep and executive functioning alterations. Finally, through Path Analysis, it is verified that state anxiety is the variable with the greatest weight within the model that would explain the alteration in the executive functioning of the present sample.

Keywords: executive functions, sleep, anxiety, adolescents, children, confinement, COVID-19

INTRODUCTION

On March 11, 2020, the World Health Organization (WHO) stated a global pandemic caused by COVID-19. Since the beginning of the alert until 24 of May 2020, 235.772 cases of COVID-19 have been reported in Spain, 1.976.120 (Red Nacional de Vigilancia Epidemiológica. Conserjería de Salud and de Epidemiología, 2020) in Europe and 5.165.481 worldwide. Given the rapid spread of the virus, all countries have had to take measures to prevent the collapse of their respective health systems. The WHO suggests social isolation, limitation of mobility and quarantining the population as the most effective strategy in containing and mitigating the speed of transmission of the infection. From March 14 to June 21, 2020 a state of alarm was declared in Spain and with it the closure of many workplaces, including primary schools, secondary schools and universities (Royal Decree 463/2020, of March 14, BOE N°. 67; España, 2020). Since then, the entire population has been forced to remain homebound for long periods of time. Many adults have experienced alterations in their work, financial, and personal situation. In addition, children and adolescents have completely restricted social contact with their peers and significantly limited their physical activity (Danese et al., 2020), causing major changes in their daily routines, and what was previously considered a normal day is now unfeasible. In record time, the population has been forced to adapt to new living conditions unthinkable a week before the onset of state of alarm.

The growing number of patients, the expansion through different provinces and the unpredictable future of the epidemic have raised the concern of the entire population. In addition, other collateral damage of an economic, employment, social and personal nature, such as the loss of a job or loved ones has aggravated the situation (Danese et al., 2020). All of this has caused high psychological pressure on people in different countries (Duan and Zhu, 2020), with the mental health of adults, children and adolescents being diminished, producing changes in mood, behavior and other daily habits (Chen et al., 2020; Li S. W. et al., 2020; Yang et al., 2020).

A sector of society that is highly susceptible to vulnerability is the child and adolescent population since the contexts in which they live and develop are altered. Although there are few studies on the responses of this population to epidemics (Klein et al., 2009), there is a large body of research that shows that children and adolescents in situations of prolonged stress may experience immediate or long-term mental health problems (Laor et al., 1997; Hoven et al., 2005; Plourde et al., 2017; Han and Lee, 2018; Bender et al., 2020; Park et al., 2020). Quarantine and hospitalization of the child or their family members are conditions that can generate high levels of stress, in the same way limited access to mental health services during quarantine can aggravate previous psychological problems or lead to new difficulties (Espada et al., 2020). Emotional stress has neurobiological consequences that increase the probability of exacerbating concomitant illnesses and the vulnerability to meeting criteria for a mental disorder such as anxiety disorders, depression, sleep disorders, and acute stress, among others (Asmundson and Taylor, 2020; Bender et al., 2020; Ji et al., 2020; Vahia et al., 2020).

Mood disorders, in their different types and varieties, constitute one of the most diagnosed psychological problems in children and adolescents in Spain, as well as being the highest demand for care within Infant-Youth Mental Health Units, with rates between 20 and 39% for conduct disorders; between 17 and 26% for anxiety disorders; between 4 and 14% for depression; and around 12% for developmental disorders (Bernstein et al., 1996; Aláez et al., 2000; Echeburúa and de Corral, 2009). Their prevalence can be considerably affected depending on different variables (age, previous and / or parental psychopathology, psychosocial stressors, etc.), which can condition the severity or duration of the symptoms and predict the evolution toward more severe pathologies in future developmental stages (Bragado and Bersabé, 2000; Orgilés et al., 2012), becoming a risk factor for depression (Huberty, 2012). Specifically, the extraordinary situation to which minors are exposed due to the long period of confinement in the home as well as the threats posed by the pandemic, together with their own personal and family circumstances, lead to a higher probability of the appearance and greater impact of symptoms related to this disorder in its different manifestations (Chen et al., 2020; Li S. W. et al., 2020; Yang et al., 2020).

Anxiety and depressive disorders have a complex and bidirectional relationship with sleep disorders (Johnson et al., 2000). Sleep is an evolutionary and active process that begins prenatally as a result of dynamic biopsychosocial balance; and its evolution depends on the harmony between these three factors (Pin-Arboledas and Lluch Rosello, 2011). The unprecedented situation that we are experiencing caused by COVID-19 affects said biopsychosocial balance. In the consensus document on the management of insomnia in childhood and adolescence prepared by Pin et al. (2017), it is concluded that 27% of children aged 5–12 years present resistance in going to sleep, 11% prolonged sleep latency, 6% frequent awakenings and 17% difficulties in getting up in the morning (Pin Arboledas et al., 2011). In adolescents, 38.5% present poor subjective sleep quality and 23.1% have sleep latency greater than 30 min (García-Jiménez et al., 2004). In addition, it is indicated that sleep-related problems can have a significant impact on both emotional and cognitive levels, as well as on learning.

Along with emotional and sleep difficulties, it is not unreasonable to think that cognitive processes can be affected in situations of confinement. It has been observed that stress, both chronic and acute, affects cognitive processes governed by the Prefrontal Cortex (PFC) (Park and Moghaddam, 2017). This area dominates the processes and functions of the executive system, including working memory, self-regulation of emotions, cognitive flexibility, organization and planning, decision-making, and goal-orientated behaviors among others (Lavigne, 2009; Lavigne and Romero, 2010; Sánchez et al., 2019). Several authors highlight the role of these functions, and especially those related to planning, as possible mediators between perceived stress and subjective memory complaints (Ruiz-Sánchez de León et al., 2010; Molina-Rodríguez et al., 2016). Molina-Rodríguez et al. (2018) further reveal that in stressful situations, perceived stress

will be inversely related to the level of executive control and attention problems.

In typical adults, research suggests that anxiety interferes with efficient cognitive processing on tasks involving executive function (Eysenck et al., 2007; Shields et al., 2016). Also, acute stress impairs executive function in part by increasing noradrenaline (Alexander et al., 2007) and state anxiety is correlated with noradrenergic receptor occupation (Yu et al., 2008). Thus, anxiety may impair executive function by both draining cognitive resources and concurrently enhancing noradrenergic activity. Furthermore, PFC has a high level of neuroplasticity throughout life, being especially sensitive during childhood and adolescence (Munakata et al., 2004). Specifically, it has been observed that in these stages, behavioral stress can generate changes at both a structural and functional level in PFC by modulating neuronal, molecular and chemical connections (McEwen and Morrison, 2013; Bender et al., 2020).

Confinement leads to a loss of routine, a reduction in social and physical contact, frustration, boredom and a sense of loneliness that can be difficult to manage for many people (Rodríguez, 2020). Studies related to the effect of quarantine periods in other health crises such as the epidemic outbreak of Severe Acute Respiratory Syndrome (SARS) (2003), Ebola (2014) or influenza AH1N1 (2009, 2010), allow us to predict the psychological consequences that could be derived from the current crisis (Brooks et al., 2020). These studies showed a prevalence of anxiety symptoms of up to 20% and depressive symptoms of up to 18% in the quarantined population, with health workers being significantly more affected. Sprang and Silman (2013) found that children who have been quarantined during pandemic diseases are more likely to develop acute stress disorders, adjustment disorders, and pain. Thirty percent of the children studied in isolation or quarantine met the clinical criteria for post-traumatic stress disorder. A preliminary study conducted on a sample of 320 children and adolescents aged 3–18 years in Shaanxi Province during the COVID-19 epidemic by the China-EPA-UNEPSA collaborative working group (Jiao et al., 2020) showed that children aged 3 to 6 years old were more likely than older children to manifest symptoms such as ambivalent anxiety attachment and fear that family members could become infected. Children aged 6 to 18 were more likely to show inattention and persistent inquiry. Clinging, inattention, and irritability were the most severe psychological conditions demonstrated by children in all age groups. Rates of fear, anxiety, and other emotions were higher in children residing in highly epidemic areas; however, the differences between areas identified by different levels of epidemic risk were not statistically significant. All these studies conclude that significant behavioral changes such as maintaining hyper-alertness, excessive handwashing and crowd avoidance are detected after quarantine period. Therefore, the data points to the fact that there are groups that have suffered and will suffer more from confinement such as; those with previous mental pathology, pregnant females, the elderly, health workers, and children and adolescents (Daley, 2020).

The National Child Traumatic Stress Network (2020) states the psychological response to COVID-19 will change with age. In the preschool stage, manifestations of fear, loss of appetite, increased tantrums and complaints or ambivalent anxious attachment behaviors (among others) are expected. At ages 6 to 12 years, higher rates of irritability, nightmares, sleep and appetite problems, somatic symptoms, or loss of interest in peers, as well as excessive attachment to parents, may occur. In adolescents from 13 to 18, in addition to physical symptoms, sleep problems or isolation, increased or decreased energy, higher rates of apathy or inattention to behaviors related to health care are expected.

Given the seriousness of the situation surrounding the mental health of children and adolescents, we intend to carry out this study with the following objectives: (1) To understand the consequences of confinement by COVID-19 on anxiety, sleep and executive functioning (planning/organization, self-regulation of emotions, flexibility, time management, organization/problem solving, inhibition / containment and motivation) of children and adolescents; (2) To check whether there are differences in these consequences in terms of sex on the one hand and age on the other; (3) To assess how anxiety affects executive functioning in males and females; and (4) To examine possible correlations between the variables that have been measured on the mental health of children and adolescents.

MATERIALS AND METHODS

Design

The design is multimodal, since it will include different types of methodologies according to the objectives of this study. Thus, an associative-comparative and explanatory design was used to carry out this research (Ato et al., 2013).

Participants

The initial simple was compromised of 1,033 children and adolescents, of which 1,028 (548 males, 478 females and 2 people who did not identify as either) finally participated, with ages between 6 and 18 years (M = 10.34; DT = 3.64). The sample was recruited after sending telematic questionnaires and the inclusion criteria consisted of being in quarantine due to the COVID-19 pandemic, residing in Spain and being between the ages of 6 and 18. The collaboration of the legal guardians (N = 1028) was required, with them answering the questionnaires in relation to what was observed during confinement or asking their children when necessary. Of these, 868 were females and 160 males, aged between 19 and 68 years (M = 42.94; DT = 6.78). All the legal guardians were aware of the different phases and characteristics of the study, signed the informed consent and completed the questionnaire. In the case of people over 18, they could sign the informed consent and complete the questionnaire themselves. Those who did not fully complete the questionnaire or did not provide the informed consent were excluded from the study.

The nationality of the respondents was mostly Spanish (95.9%). The relationship that these people have with the child or adolescent in 84.6% is maternal, in 12.8% paternal, in 1.4% of siblings and the rest with percentages ranging between 0.1 and 0.6%, other relationships such as grandparents, uncles, neighbors' and/or guardians.

Instruments

The instrument, designed to be completed by parents and/or legal guardians of children and adolescents from 6 to 18 years of age, takes approximately 15–20 min to complete and consists of four sections that include: (1) socio-demographic and health-related data, (2) state/trait anxiety in children and adolescents, (3) sleep, and (4) executive functioning. The first section has been elaborated *ad hoc* based on demographic and health variables that are mainly related to the contextual characteristics of minors, given the current situation. The subsequent sections gather information from different standardized scales whose items have been used and adapted in order to be completed by adult observers.

Ad hoc Questionnaire of Socio-Demographic and Clinical Data

Designed to collect information regarding sociodemographic variables such as level of education attained by informants, the monthly income of the family, the employment situation of the informant and their partner before and after the declaration of the state of alarm, employment sector to which they belong, size of the house in which they live during quarantine and exterior spaces which the house possess (window, balcony, terrace, patio, garden or exterior terrain). In addition, information was collected regarding the child's mental health, as well as whether he or she was taking medication. Lastly, it was asked whether the family unit included persons with risk factors for contracting coronavirus and whether any members had tested positive for the disease.

State-Trait Anxiety Inventory for Children, STAIC (Spielberger, 1973)

This questionnaire is derived from the State-Trait Anxiety Inventory (STAI) test. The Spanish version is applied, adapted for the first time by Spielberger et al. (1982) and currently revised on a psychometric level by Guillén-Riquelme and Buela-Casal (2011). Thus, there is a solid evidence in relation to the measured constructs, because of its long history of use in different fields (Barnes et al., 2002; Rossi and Pourtois, 2012; Guillén-Riquelme and Buela-Casal, 2014) and updated to the general Spanish population (Spielberger et al., 2015). It evaluates anxiety as a state and as a trait, constituting two independent scales made up of 20 items each with 3 response options (1 = not at all, 2 = somewhat, 3 = very much). The first scale refers to how the child feels at a given time, and the second relates to how he/she feels in general. The state anxiety scale tries to clarify "how the child feels at a given moment," and measure transitory states of anxiety, that is, feelings of apprehension and tension and concern which fluctuate in intensity over time. Examples of items used in this scale are "your child feels calm" or "your child feels restless." The trait anxiety scale measures "how the child feels in general," exploring relatively stable differences in propensity to anxiety, that is, differences between children in their tendency to show anxious states. Some items on this scale are "your child is concerned about making mistakes" or "your child feels like crying." Although the original implementation of the instrument is self-applicable with help of tutors or guardians if necessary, due to the special circumstances of the confinement and the telematic sending of the test, it was chosen that the guardians would be the ones to complete the questionnaire, in collaboration with the child when necessary. For this, the formulation of each item was adapted as previously exemplified. However, in order to guarantee the reliability of this instrument, Cronbach's alpha was calculated for each subscale. Thus, for State Anxiety, the internal coefficient is 0.91 and 0.89 for Trait Anxiety.

BEARS. Screening for Sleep Disorders in Childhood (Owens and Dalzell, 2005)

A brief sleep screening test made up by 9 items which analyses five main areas: bedtime problems (B-), excessive daytime sleepiness (E-) awakenings during the night (A-), regularity and duration of sleep (R-) and snoring (S-). The aim of this test is to detect sleep disorders in children and adolescents between the ages of 2 and 18. This test was completed by parents/guardians answering questions such as "does your child have trouble going to bed?" or "does your child have trouble waking up in the morning, does he/she seem sleepy during the day or take naps?" Each item had 7 response options, with 1 = totally disagree and 7 = totally agree, even though originally a dichotomous response was used. It was decided in the following way, since it is more appropriate at methodological level and thus provides greater relativity in the type of response. Regarding the reliability and internal consistency, the scale presents a Cronbach's alpha coefficient of alpha = 0.732 (Ramírez-Vélez et al., 2018).

Behavioral Evaluation of Executive Function: BRIEF-2 (Gioia et al., 2017). Spanish Adaptation

This tool collects information from children between the ages of 5 and 18, and assesses executive behavior in the natural environment by providing an ecological perspective of such functions. It consists of nine scales made up of 63 items with three possible response options (always, sometimes or never). These 9 scales provide measures regarding inhibition, self-monitoring, flexibility, emotional control, initiative, working memory, planning, and organization, task supervision and organization of materials (Gioia et al., 2017). These domains are adjusted forming in turn three indices: behavioral regulation, emotional regulation and cognitive regulation. In addition, it provides a global index of executive function. It has two versions that share the same structure, BRIEF 2-Family, which is answered by family members (mother, father or others) and BRIEF-2 Teachers, to be completed by the teaching staff. Given the length of the original questionnaire and the situation due to confinement, it was decided for the present work to carry out a brief screening selecting 12 items from the family version that were directly related to the objectives of the study. For this, 6 of the 8 items of the control subscale were used, 4 of the 8 items of the flexibility subscale, and 2 of the 8 items of the planning and organization subscale. Due to the selection of items for this study, the discrimination indexes of these items are presented as indicators of the reliability of the test for each of the subscales; specifically, the items that compose the subscale of emotional control have a well-defined discrimination index that ranges from 0.46 to 0.72; the

items selected from the subscale of flexibility also have a good discrimination quality between 0.29 and 0.37; and something similar exists in the items selected from the subscale of planning and organization, where there is an excellent discrimination of 0.56 in both items.

Barkley Deficits in Executive Functioning Scale. Children and Adolescents (BDEFS-CA), Short Form (Barkley, 2012)

l This scale is completed by the child's parents/guardians and evaluates information about deficits in the executive functioning of children and adolescents (between 6 and 17 years old), in daily life activities. It is composed of 20 items with four response options assess the frequency in which behavioral alterations occur (never, sometimes, often, and very often). It consists of items such as "your child wastes or mismanages his/her time" or "your child has trouble planning or preparing for upcoming events." Regarding the reliability and internal consistency, the short version of the scale presents a Cronbach's alpha coefficient of alpha = 0.732. This version constitutes a screening of the extended questionnaire (70 items), both of which bring together information from different executive domains (time management, organization/problem solving, inhibition/containment, motivation, emotional regulation).

Procedure

A single evaluation was carried out by means of an online questionnaire that combined all of the instruments. This format was chosen because of the confinement situation decreed in the country. The sample was selected based on age and COVID-19 alarm status.

On Thursday, April 16, 2020 at 7:30 p.m., the questionnaire was sent out and disseminated through social networks and local media requesting citizen collaboration to participate in the study. The questionnaire has been online for 2 weeks, closing on April 10 at 00:00 p.m.

At the beginning of the instrument, the informed consent of the parents and/or legal guardians of the participants was required, who were informed of the anonymity of their data and the exclusive use for which they were to be used. Written informed consent was obtained from the parents of all participants. In addition, the ethical principles of the Helsinki declaration were respected (World Medical Association, 2013). This study was carried out in accordance with the Ethics Committee and Vice-rectorship for Research and Knowledge Transfer of the University of Alicante in Spain (UA-2020-05-12).

Statistical Analysis

To carry out the statistical analysis, we started with the refinement of the database. For this, an exploratory analysis was carried out, duplicated cases were eliminated and inverse items were recoded.

A quantitative methodology was carried out in which frequency and descriptive analyses (mean, median, and standard deviation) were applied for the sociodemographic variables (age and sex of the participants) and the variables state anxiety, trait anxiety, sleep disturbance and executive functions. In this way, a statistical criterion was used to group the different variables into low, average and high scores, by taking the 33.3 and 66.7 percentiles as cut-off points to find out the frequency of each group, in addition to making an expert judgement by professionals from the University of Malaga and the University of Alicante. Likewise, direct scores were used to calculate a total sum (including all the items of each variable) for each of the subjects as well as an arithmetic mean to measure the average alteration of the total sample in each variable. Furthermore, prior to the analysis of differences and in order to choose the most suitable hypothesis test, the assumptions of linearity (scatter diagrams), normality (Kolmogorov-Smirnov test), independence (runs test) and homoscedasticity (Levene test) were checked (Field, 2009).

In addition, difference analyses were performed by means comparison. The parametric Student's *t* test was applied to two independent samples in order to check the differences by sex in the variables state anxiety, sleep and executive functions. ANOVA was performed to find the differences between the age groups (the sample was segmented into 3 age groups: 6–8 years, 9–12 years, and 13–18 years). Subsequently, Tukey's *post hoc* test was applied to check between which groups there were statistically significant differences. The trait anxiety variable did not meet the statistical assumptions and, therefore, the non-parametric Mann-Whitney *U* test was applied for differences by sex and the Kruskal-Wallis *H* test for differences by age group. Likewise, ANOVA was applied to check if there were statistically significant differences in sex with low, medium and high anxiety, as well as intra-sex between males with different levels of anxiety and in the same way for females. The effect size was obtained through the calculation of Cohen's d to determine the magnitude of differences by sex with respect to executive functions. Hays's omega for differences by age groups in state anxiety and sleep, and the differences between anxiety groups in executive functions. The interpretation of the effect size was according to Cohen (1988). A confidence level of 95% was established (Field, 2009).

Finally, the correlations between the children's sex, age, state anxiety, trait anxiety, sleep and executive functions were calculated, according to the interpretation of Hernández-Lalinde et al. (2018), and a Path Analysis was carried out to create a possible model to explain the influence of state/trait anxiety and sleep variables in executive functioning (measured with BRIEF-2 and BDEFS-CA).

All data were analyzed by a member of the team with experience and training in methodology, using SPSS Statistical software package, IBM SPSS Statistics v25.

RESULTS

The results obtained after the telematic completion of the above-mentioned questionnaires by the legal guardians of 1,028 children and adolescents aged 6 to 18 years (M = 10.34; SD = 3.64), who were living under a situation of confinement in Spain due to the COVID-19 pandemic, were

analyzed. Firstly, the average scores on the different scales used for the research have been calculated and compared with the average scores which appear in the test manuals, understanding the latter group as a normative non-confined population. The differences between the scores obtained by the unconfined sample and the confined sample are visibly different (**Supplementary Table 1**).

With this in mind, can be observed in **Supplementary Figure 1**, the percentage of total sample (N = 1028) with low, medium and high scores in each of the administered tests.

In order to test for differences in the mental health consequences of the COVID-19 confinement for children and adolescents based on sex, a T-test for two independent samples and the non-parametric Mann-Whitney U test were performed, as can be seen in **Supplementary Tables 2, 3**.

In addition, with the aim of checking whether there are differences in the consequences of confinement by COVID-19 on the mental health of children and adolescents depending on their age, a one-way ANOVA and the non-parametric Kruskal-Wallis H test were applied. **Supplementary Tables 4, 5** show the distribution of the sample into three homogeneous groups depending on the developmental stage in which they can be found.

On the other hand, differences between males and females with low, average and high state anxiety (SA) in relation to executive functions can be seen in **Supplementary Tables 6, 7**.

With the aim of studying the relationships between the state/trait anxiety variables and the rest of the variables measured on the mental health of children and adolescents, a correlation study was carried out (**Supplementary Table 8**). The interpretation is made according to the range of values established by Hernández-Lalinde et al. (2018).

Finally, with the purpose of finding out how variables such as State/Trait Anxiety and Sleep quality influence the executive functioning of children and adolescents a Path Analysis was performed (see **Supplementary Figure 2**).

DISCUSSION

In recent months, the study of the impact of COVID-19 pandemic on different variables has, as can be expected, aroused great interest in scientific community. However, most of these studies either use the entire population as their target sample, or remove children and adolescents, even though these are the people who will constitute the future of our society and are a group of high vulnerability. Children and adolescents are not indifferent to the dramatic impact of the COVID-19 epidemic. The change in life to which they have been abruptly subjected forces us to understand the state of their mental health, in order to adequately address both their present and future needs.

Firstly, we would like to highlight the differences found between the means obtained by the subjects of the sample of the present study, who are in a situation of confinement at the time of proving their answers, and the results obtained by other samples that are not confined. The clearest differences are observed in State-Anxiety (Unconfined = 31.2 and Confined = 34.7), in the quality of sleep (Unconfined BEARS = 7.4 and Confined BEARS = 13.18) and in difficulties in Executive Functions measured with BDEFS-CA (Unconfined = 33.2 and Confined 70.69). Based on these data, it is unquestionable that the confined population that forms part of the studied sample shows, in comparison with non-confined samples, greater deterioration in anxiety, rest and effectiveness in executive functions. This fact justifies the statements that will be carried out as a conclusion of the present investigation.

The results of the present study show that out of a sample of 1,028 children and adolescents, 66.9% and 67.9% present medium to high scores in trait and state *anxiety*, respectively. In relation to *sleep*, 40% show medium scores, 36.4% high and only 23.6% low scores. In regards to *executive functioning*, we found that between 67.1 and 68.3% of children and adolescents show medium to high scores. These findings are in line with those found by Jiao et al. (2020) who, using a sample of 320 children and adolescents between the ages of 3 and 18 and with the aim of detecting behavioral and emotional disorders during confinement, found that the most common problems presented were those related to attention, irritability, fear of asking about the coronavirus, and ambivalent attachment behaviors. However, sleep problems, lack of appetite and hyperactivity were also detected. With these findings, the researchers aim to detect people who are susceptible to pathology in order to diagnose and subsequently treat them. On the other hand, studies have also been conducted with adult population during the confinement due to the COVID-19 pandemic, in which the presence of mental health problems has also been detected. A study carried out in China by Cao et al. (2020) with university students during the beginning of the pandemic found that 24.9% had severe-moderate to medium anxiety (0.9, 2.7, and 21.3%), as well as verifying that social support negatively correlates with the anxiety levels ($p < 0.001$), suggesting monitoring this population during epidemics, as to avoid deterioration in mental health. Likewise, Li S. W. et al. (2020), in a study carried out with 17,865 adult participants, found that negative emotions such as anxiety, depression, outrage, and sensitivity to social risks increased, while positive emotions and feelings such as happiness and satisfaction with life decreased. The conditions that social isolation generates are configured as a non-normative stressor that increases the possibility of presenting mental problems for the first time or the exacerbation or recurrence of pre-existing mental disorders (Asmundson and Taylor, 2020).

In order to study differences health of our sample depending on sex, as shown by the analyzed results, being male or female does not determine the presence in the studied sample of more or less anxiety or sleep problems. However, statistically significant differences are found in executive functioning, in favor of women, with a small effect size, so they would not be considered clinically relevant. In other words, male children and adolescents show more alterations in planning and organizing, ability to self-regulate their emotions, manage time well, solve problems,

be motivated, adapt to different circumstances, and inhibit inappropriate behavior.

Research conducted with the intention of determining the existence of differences in executive functioning regarding sex, shows non-congruent findings. There are studies with population of up to 6 years old that find better levels of executive functioning in females than in males, especially in inhibitory and emotional control and resistance to delay (Matthews et al., 2009). In contrast, other studies have failed to find such differences (Ferreira et al., 2015). In a study carried out in Spain with a sample of 66 students aged between 5 and 6 years old, using the BRIEF-P scale, Romero-López et al. (2016), it was found that females obtained significantly higher scores than males in inhibition, memory and planning, however, males obtained higher scores in flexibility. No significant differences were found in the remaining variables that were analyzed on executive functioning. Studies with adolescents indicate the same controversies; some find a difference between adolescent males and females (Sant'Anna et al., 2007) and some do not (Archana et al., 2014). However, these studies were not carried out in situations of confinement. One study that was carried out under these circumstances, but with a sample of 1,210 adults instead of children, was the study conducted in China by Wang et al. (2020), which found that being a woman, among other variables such as being a student, having previous symptoms such as myalgia, dizziness, coryza and a poor perception of one's health, is associated with a greater psychological impact and high levels of stress and symptoms of anxiety and depression. Likewise, in another study carried out with adult Chinese population, it was also found that women presented a higher level of anxiety than men (Lozano-Vargas, 2020).

Regarding the variable of age, the data show differences between the groups. On the one hand, the pre-adolescents and adolescents obtained higher levels of anxiety, while for the variable of sleep adolescents were those who showed more alarming scores, with small effect sizes as indicated. The findings related to anxiety are in line with other authors who indicate that from pre-adolescence onwards, anxiety problems are accentuated, specifically generalized anxiety disorders (García-López et al., 2001; Kendall and Pimentel, 2003; Orgilés et al., 2012). In contrast, in younger children there are symptoms related to separation anxiety (Orgilés et al., 2011). Given that the confinement situation involves being at home with their parents, it is not uncommon for younger children to feel more protected, and therefore less anxious. In addition, adolescents' perception and understanding of the problem is more direct and real than in younger children who are usually guided by their parents.

On the other hand, the results indicate that adolescents, unlike children and pre-adolescents, show significant sleep disturbances. Various studies postulate that age and hours of sleep are naturally inversely related (Gibson et al., 2006; Velayos, 2009). Furthermore, factors such as decreased physical activity, changes in routine and the precipitation of stressful events can cause sleep disturbances (Åkerstedt, 2006; Kredlow et al., 2015; Willis and Gregory, 2015). Some studies also point out that in adolescence other elements such as the use of electronic resources such as mobile phones, computers, and time on social network, contribute to the decrease in quality and hours of sleep (Billieux, 2012; Sahin et al., 2013). Specifically, in the study carried out by Rodríguez (2016) it was observed that the pattern of use in pre-adolescents is considerably lower than that of adolescents, thus causing alterations in the sleep-wake cycle, especially in the latter group. Furthermore, the absence of social contact with peers due to the confinement situation could lead to an increase in technology consumption, problems in falling asleep and difficulties in concentrating and achieving an adequate academic performance (Lin et al., 2011; Wang et al., 2011; Tresáncoras et al., 2017; Piqueras and Carrasco, 2018).

As the results regarding anxiety and executive functions show, we observed that the anxious symptoms associated with the period of confinement can justify a lower performance in the subjects' executive functioning. Specifically, when comparing groups of males and females who present high levels of anxiety, a significant difference is observed in executive functioning (which are especially pronounced in men). Likewise, when analyzing groups with or without manifestations of anxiety, significantly lower scores in executive functions were observed in those groups (both males and females) that present higher levels of anxious symptoms, compared to those without anxiety. In all cases with a clinically significant effect size. As mentioned previously, the general population in countries such as China has suffered, in more than 50% of cases, the impact of the psychological symptoms of the pandemic. Specifically, 28.8% have experienced anxious symptoms (moderate-severe), throughout the first weeks of quarantine (Lozano-Vargas, 2020). However, we still do not have sufficient data regarding the emotional and cognitive consequences that this situation is having on younger age groups.

Along these lines, the work of Bragado and Bersabé (2000), carried out with three groups of children and adolescents: 67 subjects (with symptoms compatible with any type of anxiety disorder), 101 cases (clinical control group), as well as 155 (control group without pathology), aged between 6 and 17 years old, explores some of the risk factors associated with the detection of anxiety disorders. The results are especially relevant between the anxious group and the neurotypical controls, observing significant scores that point to stressful events, academic difficulties or psychopathological state of the parents as risk factors, among others. These types of factors allow discriminating between children with anxiety and children without pathology up to 85.58% using a multiple regression model.

In line with our results, the work of Márquez (2007) justifies the complexity of the neural substrate of anxiety and its relationship with cognitive mechanisms such as memory and executive functions, as well as adding that patients with generalized anxiety disorder manifest problems related to their poor executive capacity (notorious in deficits to plan, decision making or problem solving, among others). Moreover, executive disorders tend to have a higher prevalence in men during childhood and adolescence, being likely due to the strong association they show with various mental and neurodevelopmental disorders such as (Bausela-Herreras, 2012): attention deficit hyperactivity disorder, autism spectrum disorders, traumatic brain injuries, epilepsy, etc.

Likewise, the systematic review carried out by Langarita and Gracia (2019) addresses forty articles with a total sample of 1,098 cases that present symptoms compatible with generalized anxiety. Its aim is to explore the neuropsychological profile of subjects diagnosed with this disorder. Regarding executive functions, significantly lower scores are observed in cognitive flexibility (Tempesta et al., 2013), decision making (DeVido et al., 2009), regulation of emotions with negative valence (Kerns et al., 2014) and cognitive inhibition (Kalanthroff et al., 2017), however, no significant differences were found in behavioral inhibition between groups.

Finally, and with the aim of studying the correlations between the variables on the mental health of children and adolescents that have been measured, the data found supports the hypothesis that there is a strong correlation between state anxiety and sleep disturbances, on the one hand, and executive functioning on the other. However, although a correlation was found between all variables and trait anxiety, this correlation was not as strong. This would explain that state anxiety was the variable with highest weight (0.34 and 0.25) within the model that would explain the low scores in executive functioning of the present sample (see **Supplementary Figure 2**). These data suggest that the confinement situation due to the current pandemic may be affecting anxiety in the 6–18 year old population, which in turn may affect sleep and negatively impact executive functioning. However, the state of anxiety, sleep disturbances and alterations in executive functioning can vary over time and fluctuate in intensity, and even more so in this current situation. Psychological reactions to a pandemic are usually acute, and long-term emotional consequences can be observed (Li Z. et al., 2020). There is no doubt that due to the confinement caused by the current pandemic we are detecting changes in the mental health of children and adolescents from 6 to 18 years old. Coinciding with the reflections of Sprang and Silman (2013), it is recommended that all children and adolescents who present symptoms of anxiety, depression, sleep problems, executive disorders, among others, receive a psychological or psycho-pedagogical follow-up after the pandemic. However, if during the pandemic these symptoms are detected, something must be done to avoid this situation continuing after the post-pandemic, therefore, it would be recommended that those responsible for socio-educational and health policies -in this case linked to child and youth mental health-, implement public programmes that help prevent and/or treat the problems that the COVID-19 pandemic may generate on the mental health of children and young people.

Therefore, the results obtained in the present study contribute theoretically to knowing how and which people may be most affected during the confinement situation. This will allow in practice to detect early possible alterations in the mental health of children and adolescents, and initiate an early response in future situations of pseudo-confinement or confinement.

As the main limitation of the present study, we highlight the lack of a pretest or retest on the study sample, data with which it would be possible to compare to what degree the scores obtained are mainly generated by the current situation.

Derived from this study, three future investigations are projected that would complement the obtained results. First, to carry out a new collection of information for the same sample, once the current situation has been overcome, and the subjects of the study have recovered part of the psychosocial habits that characterize their day to day lives. Secondly, it would be very interesting to collect information about the cognitive ability of the subjects, in order to carry out a new study on the explanatory model, including this variable due to its determine nature when explaining the development of executive functions. Thirdly, to develop intervention programs to prevent and/or treat the difficulties found in the subjects surveyed with the aim of minimizing the possible consequences that confinement has generated, both in their levels of anxiety and quality of sleep, as well as in their executive functioning. The actions could be oriented toward the design and development of social and educational strategies that allow sufficient health measures to be carried out, without disrupting the life and routine of the most fragile population, children and adolescents.

Therefore, the perspectives of the present study are multiple. Firstly, it seeks to delve into the possible consequences in medium-long term that confinement may be causing in child and youth population. In addition, it is desired to expand this work to understand other variables that may be influencing the factors studied. And finally, it is intended to provide information to different government agencies in order to develop future protocols and action programs.

DATA AVAILABILITY STATEMENT

The datasets generated and analyzed for this study are available on Google Drive at: https://drive.google.com/drive/folders/1tDOMFKMnhsz6dLp0SEiT7jjpfN604PYV?usp=sharing.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of the University of Alicante. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

RL-C, IN-S, RJ-RM, BC-L, MR-F, and MS-ML collected and processed the experimental data, performed the analysis, drafted the manuscript, and designed the figures. RL-C and IN-S were responsible for conceiving the idea of the study. IN-S and RL-C were involved in planning and supervising the study. BC-L and MR-F were responsible for most of the technical aspects of the study and conducted the statistical analyses. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.565516/full#supplementary-material

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Analysis and Psychoeducational Implications of the Behavior Factor During the COVID-19 Emergency

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This theoretical analysis seeks to contribute to three objectives within the context of the proposed *Frontiers* Research Topic: (1) delimit two levels of analysis in the present pandemic situation: medicine-epidemiology and behavioral psychology, still under-addressed. While medicine has its essential role on the biological side, psychology has a comparable role on the behavioral side. (2) Analyze the importance of behavioral-educational factors in the pandemic situation, using a precise theoretical model from educational psychology for this analysis. (3) Propose preventive, psychoeducational intervention strategies based on the previous analyses.

Keywords: COVID-19, psychology, educational psychology, self-regulated learning vs. externally-regulated learning theory, implications for intervention

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INTRODUCTION

When the COVID-19 pandemic appeared in early 2020, every effort was made in the scientific and professional world to understand its impact, know how the virus functions, and develop strategies for prevention and eradication (Brooks et al., 2020; Chacón-Fuertes et al., 2020; Leung et al., 2020). Thus, an enormous amount of basic and applied research has been dedicated to this purpose (Alessandri et al., 2020; Castelnuovo et al., 2020; WHO Regional Office for Europe, 2020). Given the characteristics of this health problem, epidemiological science – as a scientific branch of medicine – has played a leading role in the profusion of data, design of preventive measures and population monitoring, as well as in establishing measures to contain the disease. Considerable research also addresses the problem of fighting the disease in a therapeutic sense, from the biological and biomedical standpoint (Huremovic, 2019).

From a psychological viewpoint, research has largely been aimed at assessing the impact on persons' mental, emotional and behavioral health from the periods of confinement that a large part of the population has been subjected to (Lippold et al., 2020; Spalleta et al., 2020). The effects of confinement on mental health have been analyzed by a number of authors (Taylor, 2019a,b,c; Sokolowska et al., 2020). Parallel analyses have also been carried out from the viewpoint of *cultural and socio-communitarian psychology*, as well as from positive psychology (Whillans et al., 2020) and from the approach of the mass media (Arriaga et al., 2020).

However, these studies do not exhaust the analysis of the pandemic phenomenon and its many components, given that there are other perspectives. The *Educational Psychology perspective* is

relevant and specific because it focuses on the impact that this new situation is having on the developmental and learning processes of the persons involved, not to mention the preventive behavioral change that is needed to adaptively face this unprecedented situation (de la Fuente et al., 2020b). Understanding this reality is especially important in the different educational environments, such as the family, the school, the socio-educational context, and the new technological contexts of nonformal education (Li and Xie, 2020). It is also necessary to analyze the different stages of education (Cao et al., 2020; Wilke et al., 2020). The present research topic addresses this object of study, from a psychoeducational perspective (de la Fuente et al., 2020b).

In response, this study seeks to contribute to three objectives within the context of the *Frontiers Research Topic*: (1) delimit two levels of analysis in the current situation: the biological level and the – still under-addressed – behavioral level. While medicine has its essential role in the biological side, psychology has a comparable role in the behavioral side. (2) Analyze the importance of behavioral-educational factors in the pandemic situation, using a precise theoretical model of analysis. (3) Propose preventive, psychoeducational intervention strategies based on the previous analyses.

ON HUMAN HARDWARE AND SOFTWARE: THE ROLES OF MEDICINE AND PSYCHOLOGY IN HEALTH

When students ask what the difference is between the object and scope of Medicine vs. Psychology, the computer offers a graphic metaphor (de la Fuente, 2020a). This metaphor makes it easier to understand that human beings can be categorized into two levels for analysis: their "hardware" and "software." The *hardware level of analysis* refers to the structural and functional aspects of the human being's physical equipment (biological, physiological, biochemical, neurological, and hereditary), with which we come into the world. Included are all the body's biological systems, structural and functional, that allow it to be a living organism in its environment. It is then the structural and functional equivalent of the computer's physical equipment that allows it to function as such (cables, connections, and microchips). The *software level of analysis* refers to structural and functional aspects that are psychological in nature, allowing the human being to acquire the specific learning programs for behavioral adaptation to his or her environment, through education. Consequently, this level is comparable to programs installed on a computer, allowing it to execute tasks and productive actions: data analysis, word-processing, graphic design, machine learning, big data, and so on.

Anyone who understands computers knows that optimal hardware (memory, motherboard, and processing speed) and adequate software (installed programs) are both required. It is possible for good hardware to not be accompanied by good software. In other words, optimal physical equipment will not achieve high standards of performance if not accompanied by optimal programming, and vice versa. In the sphere of human development, this concept is classically referred to as nature (genetic) vs. nurture (learning/environment). For many years, the controversy on genetics (hardware) vs. environment (software) filled endless numbers of studies and research positionings as to the relative weight of the two factors. We know today, and it is obvious to all, that the two factors combine to determine the final human product.

There are two clear distinctions, however, where the computer metaphor falls short. On one hand is the material with which computers and people are composed. While the computer contains hardware built with physical components (silicon, etc.), the human being has biological or biochemical hardware. On the other hand, while computer hardware and software do not modify each other when interacting (at least, in the classical design), such modification does take place in the human being.

Concerning the first issue, *biological hardware* can explain a significant part of behavior, but not all. Genetics, physiology and neurology are essential to explaining the biological basis of human behavior. This is the sphere of medicine (biological, physiological, biochemical and neurological science, i.e., human hardware). However, common knowledge and formal science both offer evidence that learning and experiences also play an important role in accounting for human behavior. This is the sphere of *psychology* (the science of behavior or of human software). Put differently, human beings and their health are the object of study of both sciences. In the former, biological explanatory models are created (biological hardware models), while in the latter, models are based on behavior (behavioral software models). As with computers, it is easily understood that neither of the two parts, on its own, can fully explain effective functioning. The historical error lay in trying to explain human functioning solely on the basis of the hardware. In other words, not enough weight was given to behavior in explaining health issues and level of functioning. This first idea has a central implication in the health sphere: the factors that determine health include both hardware (biological equipment) and software (the programming that results from behavior). Physical (biological) health and psychological (behavioral) health are equally important.

As for our second distinction, human beings are unlike computers in that the two levels of hardware and software are interconnected and modify each other. As noted above, the software in a computer – at least, on classic computers – does not usually modify how the hardware functions. The fact that this does occur in the human being must be analyzed if we wish to explain deficiencies or optimize functioning. In the human being, the biological interaction between software and hardware is not mechanical and it produces cross effects, unlike a computer. In other words, implantation of a certain "software program" (psychological experiences or human learning) ends up affecting and modifying the initial hardware (biological equipment). While many classical diseases are obviously problems specific to the biological level (malfunctioning of biological hardware, such as organs), epidemiological studies

show that many other diseases are produced by poor acquired habits, consolidated over time (inadequate "software," such as smoking or alcohol abuse). Such habits finally have negative repercussions on the organs or systems involved, and disease appears at the biological level (lung cancer or cirrhosis). Therein lies the value of learning experiences ("software") in health problems.

For this reason, experts in human hardware (biologists and medical doctors, in general) analyze the structure and functioning of the physical equipment, studying at great length how to ensure good biological functioning. Neurologists, for example, study and analyze the biological, structural, and functional equipment of the brain; cardiologists, the structure and function of the heart and the circulatory system. By contrast, experts in human software (health and clinical psychologists, in particular) analyze the structure and functioning of common learning programs, that is, habits, and the behavioral and emotional factors involved in the health issue at hand, using models constructed from recent evidence to explain health and disease.

This differentiation is key to understanding these two complementary lines of work in the sphere of health. While *Medicine*, as a biological science, focuses on the study of physical or biological factors of health (human hardware factors), *Psychology*, as a behavioral science, studies the behavioral factors of health (human software factors). While it is true that one branch of Medicine, Psychiatry, concerns itself with Mental Health, we must not forget that its models of assessment and intervention are preferably medical, that is, pharmacological, neurological or psychotherapeutic. Perhaps in this way we can understand that psychologists are very much needed in common health issues (general healthcare psychologists and qualified healthcare workers). Examples include psychological monitoring of patients with cancer, improving treatment adherence in chronic disease, designing programs to optimize emotional and behavioral health in senior citizens, determining the psychological and behavioral impact of pharmacological treatments, and so on. This is even more evident now with the COVID-19 pandemic.

Consider the evidence and today's knowledge of how psychological programs produce beneficial effects in the emotional and behavioral adjustment of patients with cancer. Is it comprehensible in the 21st century that these treatments are not administered in Primary Care at hospitals, nor are they covered by medical insurance? Such treatment must be carried out outside the hospital context as an external activity. This is just one example that can be extrapolated to heart attack victims, chronic disease, smoking, post-traumatic stress, etc.

Empirical evidence supports the fact that preventive intervention in health care (software programs) – whether primary, secondary, tertiary or quaternary – forestalls many later hospitalizations (hardware issues). It is time that those responsible for healthcare management understand that hardware is not the only question, but also software to a large degree. We must, therefore, work toward whole-person intervention for improving health, both from the biological sphere and from the psychological. Much work remains to be done.

THE ROLE OF EDUCATIONAL PSYCHOLOGY AS AN APPLIED SCIENCE, WITHIN THE REALITY OF THE COVID-19 EPIDEMIC

Educational Psychology is the branch of psychological science that analyzes educational problems using models and paradigmatic, scientific knowledge from psychology, applying it to education (de la Fuente et al., 2018). Working within each branch of knowledge leads to scientific and professional specialization, associated with a specific domain and level of study, whether micro-analysis (neuropsychology), molecular analysis (clinical psychology) or molar analysis (educational, social and health psychology; de la Fuente et al., 2019a). In today's specific context, educational psychology as a discipline analyzes several problem areas:

1. How the COVID-19 experience is affecting the different aspects of *psychological development* at each age (Liu et al., 2020; Yoshikawa et al., 2020). If we adopt the approach of whole-person development (physical, socio-moral, motor, cognitive and linguistic), studying the impact in these different aspects should be of interest. Also of interest are peer relations mediated by technology, as well as the impact on pre-existing problems in this area, such as cyberbullying, sexting, and so on (Alemany-Arrebola et al., 2020). We analyze how this experience of stress produces effects in different stages of education, as well as how to address and promote behavioral health, based on models that have contributed empirical evidence.
2. How the COVID-19 experience is affecting processes of *academic and scholastic learning*. This involves analyzing the causes and effects of different forms of learning (Cachón-Zagalaz et al., 2020). Well-adjusted use of technology in the teaching-learning process, its effect, and associated emotionality are important. Researchers are also concerned with the experiences of adaptational stress in students, teachers, and parents within this scenario (Valadez et al., 2020). In complementary fashion, innovation in teaching processes, based on new technologies and methodologies, is of great interest (de la Fuente, 2020c).
3. How the COVID-19 experience is affecting *different educational contexts*. Effects within the family context are important when detecting problem areas and establishing guidelines for intervention. Also important is the effect on academic achievement and construction of scholastic and academic competencies, including the areas of special educational needs and attention to diversity (Alemany-Arrebola et al., 2020; Martarelli et al., 2020; Zaccoletti et al., 2020).
4. The *use and abuse of ICT* merits its own chapter, especially in developed societies, where the use of everything online has shot up exponentially during this period (Obrero-Gaitán et al., 2020).

EPIDEMIOLOGICAL VS. BEHAVIORAL ANALYSIS FOR PREVENTION, DURING THE COVID-19 CRISIS

Epidemiological Analysis for COVID-19 Prevention

From the epidemiological point of view, *health literacy* is the process of obtaining knowledge, motivation, and individual competencies to be able to understand and gain access to health-related information, to express one's opinions, and to make decisions concerning the promotion and maintenance of one's health. It is applicable in different contexts and settings throughout one's life span (Lazcano-Ponce and Alpuche-Aranda, 2020). This conceptual perspective is very much needed in the present COVID-19 emergency, where the pandemic has produced devastating effects not only in health but also in the economic, political and social realms. These authors have established the elements that guide *public policies of prevention and control,* including:

1. *Epidemiological intelligence,* which includes not only the population surveillance strategy but, given the impossibility of identifying all positive cases, implementation of sentinel surveillance strategies and event-based surveillance (Proyecto Covid-19, 2020).
2. *Measures to mitigate the spread of the epidemic*, such as social distancing and hygiene, hand washing, quarantine, restriction of movement and use of face masks, among others. Clarity and certainty are critical elements for preserving trust and decreasing social concern. The following may be considered key community mitigation strategies:

    - Cancellation of private and public events.
    - School closures and suspension of religious services, musical and cultural events, etc. This element is key because these places are characterized by density of persons. For example, we find 3-5 m^2 per child at school, compared to 18m^2 per person at offices and 36-44 m^2 per person, ideally, in homes.
    - Direct measures of social distancing and preventing close contact between members of a community.
    - Travel restrictions, including reduced flights, public transportation and restrictions on nonessential movement.
    - Voluntary quarantine of family members at home.
    - Restrictions on attending funeral services and minimizing exposure to bodily fluids.
    - Efficient communication from health authorities at the national and international levels, reporting true information and avoiding fake news, rumors and panic.

3. *Measures to stop the spread* when the number of cases is very high, such as more drastic measures of confinement at home or the *use of masks*. Here we can mention certain recommendations in the light of common errors in using a mask. Specifically:

    - Do not wear the mask under your nose.
    - Do not leave your chin exposed.
    - Do not wear the mask loosely, with open spaces on the sides.
    - Do not wear the mask so that it only covers the tip of your nose.
    - Do not place the mask under your chin, so that it rests around your neck.
    - Wear the mask so that it comes all the way up, near the bridge of the nose, and covers down below the chin.
    - Do your best to tighten the loops so that they fit to your face and do not leave open spaces.
    - Wash your hands before and after using a mask.
    - Hold the mask by the loops when putting it on and taking it off.
    - Avoid touching the front of the mask when taking it off.
    - For apartment dwellers, wear the mask when inside the building. Elevators and stairs can be highly contaminated areas.
    - Wash and dry cloth masks daily, and store them in a clean, dry place.
    - Avoid adopting a false sense of safety.

4. *Reinforcement of medical care capacity* in healthcare systems and increased ability to prevent transmission in healthcare services, including the use of diagnostic tests.

Psychoeducational Behavioral Analysis for Prevention, in the COVID-19 Crisis

From the psychological or behavioral point of view, prevention in individuals and communities is a "problem of managing behavior change, based on a competency model, in order to respond to the new demands of the epidemiological context, contributing to non-contagion and stopping the spread of the virus, while ensuring a certain level of general health." Let us carefully analyze the components of this definition:

1. *Management of behavioral change.* Producing behavioral change in the population is the most difficult task in a complex epidemiological context such as in COVID-19. For many years, the science of psychology has analyzed this object of study, conscious of the complexity of inducing or predisposing changes in human behavior. Scientific models of this phenomenon have been developed (Hagger et al., 2020). Educational Psychology, specifically, has analyzed the difficulties inherent in behavior changes in different educational contexts (de la Fuente, 2017). It is, therefore, neither scientific nor realistic to expect people to modify their behavior only because they are asked to do so, or by giving them information about the dangers of the virus. Such change – subject to complex behavioral laws – will only be possible if: (1) External conditions are adequately designed, predisposing change in the desired direction (context factors), and (2) the person has prior competencies for dealing with change (individual factors).
2. *Based on a Competency Model.* For behavioral change to be produced, the person must be competent, that is, must possess behaviors or prerequisite skills involved in such change. The characteristic competency model of educational psychology (Gagne et al., 1988; Gagne, 1997; de la Fuente, 2015) has established that a person is competent when three levels of behavior have been incorporated: KNOWING (behavioral knowledge and principles) + KNOW-HOW

(behavioral skills and meta-skills) + MINDSET (behavioral attitudes, values and habits; Westera, 2001):

Knowing: In the case that concerns us, this means having *adequate information* (causes, consequences, effects, mechanisms of transmission, types of masks, activities allowed, and harmful practices), as well as *adequate training* (personal principles of prevention, health and co-responsibility in view of the pandemic).

Know-how: This refers to *instrumental skills* for managing the situation (from basic skills like putting on a mask, to complex social skills of interaction, stress management skills, and so on). Also included are *meta-skills,* essential and central to managing one's skills, whether meta-emotional (coping strategies), meta-behavioral (self-regulation and problem solving), meta-motivational (resilience), and meta-learning skills (metacognitive strategies).

Mindset: This essential level refers to one's set of *attitudes, personal values* (character strengths), and *health habits.* It is especially important because it determines the level of motivation for adherence to behavioral change. Note that the subjective evaluation of a behavior's importance is associated both with its inherent value and with the subjective perception of risk (Lohiniva et al., 2020). For this reason precisely, we must guard against messages like "it does not affect young people." If we do not, it is highly likely that this population sector will feel invulnerable and become a very active source of contagion.

3. *The new demands of the new epidemiological context.* Everyone can observe that the new behavioral demands of the pandemic involve two types of complex behavioral readjustments:

A decrease in reinforcing behaviors, and behavioral inhibition of frustration (resistance to frustration) that is inherent in losing the usual behavioral reinforcers (free time activities and fun, outdoor activities, and loss of economic resources for interaction with reinforcers). This modification falls under the behavioral paradigm of wanting and not being able to, or attraction-avoidance (Martarelli and Wolff, 2020).

An increase in restrictive and self-care behaviors, as well as the sustained effort of continuing to perform them. This means dedicating effort and resources to new behaviors that were not carried out before (wearing a mask, keeping a safe distance, exponential increase in handwashing, new distribution of free time activities, etc.). This adjustment and behavioral modification falls under the paradigm of control-countercontrol (Martarelli et al., 2020).

4. *Contributing to stop the spread of the virus.* This involves an environmental redesign of the first order: limiting distance and social/interpersonal physical contact, as well as any human activity that promotes contagion. Given that many human reinforcers are of this type, a great effort is required in bearing with frustration and loss. This decreases the likelihood of positive emotional states and increases the likelihood of negative ones (de la Fuente, 2017).
5. *Ensuring a certain level of general health.* All this implies that a certain degree of psychological well-being must be attainable to manage the situation (Kanekar and Sharma, 2020). In other words, some amount of positive emotionality is needed to avoid falling into apathy or reactive depression, which are predisposed by such situations (Wolff et al., 2020). For this reason, resilience as a personal characteristic, attitude or first-order skill becomes essential, as do personal character strengths (Barzilay et al., 2020).

CONTRIBUTIONS FROM SRL VS. ERL THEORY TO PSYCHOEDUCATIONAL, BEHAVIORAL ANALYSIS AND PREVENTION IN THE COVID-19 CRISIS

Contributions From SRL vs. ERL Theory in the COVID-19 Crisis

Self-regulated learning (SRL) vs. externally-regulated learning (ERL) Theory (de la Fuente, 2017) seeks to explain the combination of external and internal conditions that predispose adequate behavior in response to the pandemic or other situations. In summary, it proposes the following:

1. The *competence level* of *persons* is classifiable into *three levels of regulation* [1 = low (dysregulation, or lack of self-regulation); 2 = medium (reactive regulation); and 3 = high (proactive self-regulation)]. Based on prior research, *level of self-regulation,* as a personal characteristic, is a correlate of competence and of adequate management of different skills mentioned above, such as meta-motivation, meta-emotion and meta-behavior (de la Fuente et al., 2015, 2017). Consequently, it would be a good indicator of adequate self-care management in the COVID-19 crisis. The values 1, 2, and 3 indicate a range, from a higher level of personal regulation (3), i.e., the most proactive self-regulation; to a medium or nonregulatory level (2), not proactive in self-regulation; to the lowest level of self-regulation (1), which may even reflect dysregulation (pandemic-related examples: parties to see if the virus exists, risk contests, etc.).
2. *Interpersonal contexts* are equally classifiable into *three levels of external regulation* [1 = low (dysregulating context); 2 = medium (nonregulating context); and 3 = high (highly regulatory context)]. The *level of external regulation,* as a characteristic of the context, refers to how the context encourages adequate use of the different oversight competencies mentioned above, such as meta-motivation, meta-emotion and meta-behavior (de la Fuente et al., 2019b, 2020a). Consequently, it would be a good indicator of adequate contextual aspects in the COVID-19 crisis. The values 1, 2, and 3 indicate a range, from a context that more strongly encourages personal regulation (3), i.e., most actively promoting self-regulation; to a medium or nonregulatory level (2), the context does not offer external support for regulation; to the lowest level of external regulation (1), which may even reflect external dysregulation (pandemic-related examples: contradictory rules depending on the location, public figures who model noncompliance with the restrictions, etc.).

3. The *combination* of these two factors allows us to calculate an *interactive regulation index,* between 1 and 3, based on an average of the two regulation types, producing five possible combinations (de la Fuente et al., 2019b, 2020a). The proposed five-combination heuristic enables us to analyze the most common interactive scenarios in regulation of health behaviors during the pandemic. A *regulation average* of the person-context interaction is calculated as the mean of the individual's regulation level and the regulatory level of the external context. For example, if a person has a low level of self-regulation (1 point), and their context offers a medium level of regulation (2 points), the resulting regulation average will be 1.5 points (2 + 1 = 3/2 = 1.5 point average); similarly, if the person has a medium level of regulation (2 points) and the context is low in regulation (1 point), it would produce the same average (2 + 1 = 3/2 = 1.5 point average). In another case, if a person has a high level of regulation (3 points) and interacts with a context that is low in regulation (1 point), the regulation average will be 2 points (3 + 1 = 4/2 = 2 points). The *regulation range* describing the person-context interaction increases from least favorable to most favorable: from 1 point (1-point personal Five-combination heuristicself-regulation in combination with 1-point external regulation), to a maximum of 3 points (3-point self-regulation in combination with 3-point external regulation). This heuristic, then, orders the possible combinations according to their regulation average, assigning them a *regulation rank* (regulation average of 1 = rank 1; regulation average of 1.5 = rank 2; regulation average of 2 = rank 3; regulation average of 2.5 = rank 4; and regulation average of 3 = rank 5). See **Table 1**.

Examples of SRL and ERL Levels in a Psychoeducational Analysis

Regarding Characteristics of the Self-Regulation Level (Internally Induced Regulation)

According to the SRL vs. ERL theoretical model (de la Fuente, 2017), persons will learn or become competent – to a greater or lesser degree – by having induced or predisposed themselves to different levels of self-regulation:

High Level of Regulation (Self-Regulation or Positive Proactivity Behavior)

Well-informed, accurate knowledge of the COVID-19 phenomenon. Actively seeks current, reliable information. Conceptual structure of facts, and current conceptual models: explanatory and functional models, maps of COVID-19 spread, hygiene measures, use of masks, current legislation, etc.

Well-established personal principles (ethical and/or moral), applied to the situation: coherency, common good, respect for rules, support for healthcare workers, etc.

Well-established skills in problem solving, negotiation, emotion management (Senay et al., 2010).

High level of meta-skills (self-regulation), and consequently, frustration management and adequate habits (Puchalska-Wasyl, 2014).

Inhibition of maladjusted behaviors leading to prohibited conduct or harm to the community.

High regulation of habits and attitudes. Enjoys complying with rules and takes it as an activity for self-improvement (resilience). Does not commit prohibited behaviors, even though they may be tempting in the short term.

High sensitivity and an attitude of co-responsibility and social commitment.

Commitment to limiting one's behavior, perceiving it as a contribution to the common good. Does not have desires to do the opposite, absence of psychological reactance. See theory of psychological reactance in a later section (Brehm, 1966; Brehm and Brehm, 1981).

Medium Level of Self-Regulation (Non-Regulation or Reactivity Behavior)

Inconsistent, more limited knowledge of the COVID-19 phenomenon. Incomplete information of the phenomenon, with a conceptual structure that is inconsistent in some aspects: explanatory and functional models, maps of COVID-19 spread, hygiene measures, use of masks, current legislation, etc.

Personal principles (ethical and/or moral) are not well established and are inconsistently applied in the situation: coherency,

TABLE 1 | The Utility Model™ hypothesized by self-regulated learning (SRL) vs. externally-regulated learning (ERL) theory (de la Fuente, 2017).

Combination level		Regulation aver/ rank	Regulation trend	Control of behavior*		Epidemy control*	Health SR*
SR level (range) Personal	ER level (range) Contextual			High	Low		
3 (3.85–5.00) **H**	**3** (2.84–5.00) **H**	3.0/**5**	**High-High**: high-regulation	++	–	*H*	*H*
2 (3.10–3.84) **M**	**3** (2.84–5.00) **H**	2.5/**4**	**Medium-High**: regulation	+	–	*M-H*	*M-H*
3 (3.85–5.00) **H**	**2** (2.35–2.83) **M**	2.5/**4**	**High-Medium**: regulation	+	–	*M-H*	*M-H*
2 (3.10–3.84) **M**	**2** (2.35–2.83) **M**	2.0/**3**	**Medium**: non-regulation	=	=	*M*	*M*
2 (3.10–3.84) **M**	**1** (1.00–2.34) **L**	1.5/**2**	**Medium-Low**: dys-regulation	–	+	*M-L*	*M-L*
1 (1.00–3.09) **L**	**2** (2.35–2.83) **M**	1.5/**2**	**Low-Medium**: dys-regulation	–	+	*M-L*	*M-L*
1 (1.00–3.09) **L**	**1** (1.00–2.34) **L**	1.0/**1**	**Low-Low**: high dys-regulation	–	++	*L*	*L*

**Effects analyzed in this investigation. Please see and analyze the differences with previous research reports (de la Fuente et al., 2019b, p. 12; de la Fuente et al., 2020a, p. 5). SR level, personal level of self-regulation (1–3 range); ER level, contextual level of external regulation (1–3 range); H, high level; M, medium level; L, low level; ++, greater amount; –, lesser amount.*

common good, respect for rules, support for healthcare workers, etc.

Medium skills in problem solving, negotiation, and emotion management.

Medium level of meta-skills (self-regulation), and consequently, of frustration management and adequate habits.

Inconsistent inhibition of maladjusted behaviors that lead to prohibited conduct or harm to the community.

Medium regulation of habits and attitudes. Irregular compliance with rules (off and on), does not always accept them as an activity for personal improvement (resilience). Occasionally carries out prohibited behaviors.

Medium level of sensitivity and attitude of co-responsibility and social commitment.

Partial commitment to limiting one's behavior, medium presence of psychological reactance (Brehm, 1966; Brehm and Brehm, 1981).

Low Level of Self-Regulation (Absence of Regulation or Self-Induced Dysregulation; Negative Proactivity Behavior)

Little knowledge, or distorted knowledge, of the COVID-19 phenomenon. Explanatory models and information are not up to date.

Nonexistent or distorted personal (ethical and/or moral) principles: "I have the right to."

Little skill in problem solving, negotiation, and emotion management.

Low self-regulation, and consequently, low frustration management.

Pathological self-regulation, leading to prohibited conduct or harm to the community.

Poor regulation of habits and attitudes. Enjoys breaking rules and takes it as a reaffirmation of freedom. Attends prohibited parties, secretly violates legislation.

Low level of sensitivity and attitude of co-responsibility and social commitment.

Is bothered when behavior is limited, perceiving it as a threat to personal freedom, and has desires to do the opposite. This is the phenomenon of *psychological reactance*, a contrary, affective reaction in response to regulations or impositions that affect freedom and autonomy. This reaction is especially common when people feel forced to adopt a particular opinion or participate in a specific behavior that they do not want to do, thereby prompting behaviors aimed at restoring one's autonomy (Brehm, 1966, 1972; Wicklund, 1974; Brehm and Brehm, 1981). For example, reactance often prompts people to adopt an opinion that is opposed to the beliefs or attitudes that they were encouraged or even coerced into adopting. As a consequence, reactance often increases resistance to persuasion (Brehm and Brehm, 1981). Reactance was proposed to explain many common examples of resistance in society, recognizing adverse effects of prohibition.

Causes of Reactance

Reactance is experienced whenever a free behavior is restricted (Brehm, 1966, 1972; Wicklund, 1974; Brehm and Brehm, 1981; Miller et al., 1993, 2006; Kelly and Nauta, 1997; Donnell et al., 2001; Naeem et al., 2020). A free behavior, in this context, is any act or choice that individuals might make now or very soon. Free behaviors that are perceived as especially important, that is, more important than other free behaviors, trigger observable reactance if they are frustrated. Moreover, when a broader range of free behaviors is restricted, reactance increases considerably. Research has shown that it declines with age and has an interaction effect with gender (Hong et al., 1994).

Consequences and Implications of Reactance

As the level of reactance rises, so does motivation to re-establish freedom. This response may appear even if people are not aware of this affective state. Reactance may evoke a number of *reactions:*

First, and perhaps most surprisingly, reactance may trigger *dysregulatory* behaviors that are opposed to the rules or courses of action that were imposed and encouraged (Buller et al., 1998; Seibel and Dowd, 2001). Specifically, boomerang effects are often seen, where individuals become *more* prone to perform the behavior that was restricted (Brehm, 1966). Alternatively, they may participate in similar but different acts than the behavior that has been restricted, such as smoking more often when drugs are banned; these are called related boomerang effects (see Quick and Stephenson, 2007a, 2008).

Second, other similar persons can also reestablish one's sense of freedom. For example, consider an individual who cannot participate in a particular act, like smoking a cigarette. A close friend who performs a similar behavior, like smoking marijuana, restores in part the sense of freedom, and decreases reactance. This is called indirect restoration (Brehm and Brehm, 1981) or indirect boomerang effects (see Quick and Stephenson, 2007a, 2008).

Third, reactance promotes *unfavorable attitudes* toward the prohibition or the imposed behavior (see Dillard and Shen, 2005 and Rains and Turner, 2007). For example, smoking bans might encourage attitudes contrary to these restrictions. Similarly, the message itself could be perceived as flawed or misdirected (for example, Quick and Stephenson, 2007b).

Finally, reactance provokes adverse attitudes toward the source of any restriction. In other words, the persons who prohibit certain free behaviors are considered unfavorable (Miller et al., 2007).

Regarding Characteristics of External Regulation Levels (Regulation That Is Encouraged Externally)

According to the SRL vs. ERL theoretical model (de la Fuente, 2017), contexts can be educational --in greater or lesser degree-- by inducing or predisposing different levels of self-regulation.

High Level of External Regulation: Encouraging Individuals' Regulation Externally

Defined as a situational educational context (family, schools, community context, and media, etc.) that promotes and encourages individuals' behavioral self-regulation, as well as treatment adherence, in the desired behavioral direction. This involves the use of different strategies for inducing behavioral changes:

1. *Behavioral antecedents* design: clear and precise norms that lead to consequences; creating expectations of success and social desirability; and presenting adequate models: modeling from significant adults and peers.
2. Training users in *necessary competencies* [see the section on levels of competencies: knowing (precise information and adequate principles) + know-how (training in skills and meta-skills) + mindset (adequate motivation, through expectancy-value models)].
3. *Behavioral consequences* design: application of contingencies with high probability: intermittent reinforcement design and cost of response programs with well-designed contingency rates. Vicarious social reinforcement in adequate doses.

Medium Level of External Regulation: Neither Favoring nor Discouraging Individuals' Regulation

Defined as a situational context (family, schools, community context, and media, etc.) that does not consistently promote or aid individuals' behavioral self-regulation and treatment adherence (desired behavioral change). This involves the use of different strategies for noncontingent inducement of behavioral changes:

1. *Behavioral antecedents* design: norms are clear and precise, but do not lead to consequences; expectations of success or social desirability are not created; subjects are requested to make changes; and models presented are uncertain or ambiguous.
2. Partial or incomplete training in *necessary competencies* (see the section defining level of competencies): knowing + know-how + mindset are up to the subject, and depend on the subject's level of prior competence.
3. *Behavior consequences* design: contingencies applied with low or uncertain probability, reinforcement and cost of response programs are poorly designed and with nonexistent external contingency rates (Mazar and Zhong, 2010; Longoni et al., 2014). Reinforcement is left up to the subject.

Low Level of External Regulation: Encouraging Individuals' Dysregulation

Defined as a situational context (family, schools, community context, and media, etc.) that promotes or leads to individuals' dysregulation and behaviors contrary to those intended; adherence to behavioral change contrary to the desired behavior. Different conditions are involved:

1. *Behavioral antecedents* design: infringement of norms leads to reinforcing consequences; inadequate expectations of success and social desirability are created; and harmful models are presented as adequate. Exposure to dysregulatory modeling.
2. Users inadequately trained in *necessary competencies* [see the section defining level of competencies: knowing (imprecise information and inadequate principles) + know-how (dysregulatory skills and meta-skills) + mindset (inadequate motivation, through expectancy-value models)].
3. *Behavioral consequences* design: contingencies applied with high probability to inadequate behaviors; intermittent reinforcement design and cost of response programs with irregular contingency rates.

IMPLICATIONS FOR PSYCHOEDUCATIONAL BEHAVIORAL INTERVENTION DURING THE COVID-19 CRISIS

In the Sphere of Personal Competence

The design and development of programs to build competence in coping with the COVID-19 pandemic cannot be delayed. These should be based on the competencies model, assisting with training at each of its psychoeducational levels (Gagne, 1997), just as in its application to other problem areas.

Implementation of these preventive programs at all educational levels is essential, especially in reference to psychological or behavioral variables that predict self-regulation and adherence to proposed health treatment. We need educators that are well trained in this model, for proactive prevention of COVID-19 in schools at all levels.

In the Educational Sphere of Family and School

Family and School Contexts That Externally Promote Regulation (Regulatory Contexts)

1. *Well-ordered behaviors and predictable environment.* In the family, the existence of flexible, reasonable norms that are understood by all promotes external regulation of sons and daughters. Environmental design is a first-order regulatory factor; as an antecedent of behavior, it helps to regulate it, since it constitutes a set of discriminatory signals that create expectations and behavioral value regarding what is expected to happen.

   The behaviors of adults and older siblings are essential elements of the regulatory environment, given that they act as daily behavior models and mold behavior with their reinforcing interactions, social punishment, withdrawals of attention, and response costs (Fuentes et al., 2015). In this regard, behavioral consequences should be regular, stable and consistent, and should be applied in such a way as to minimize psychological reactance, referred to earlier.
2. *Adequate, emotionally close regulation models.* Blunt prohibitions induce reactance and have no place in this context – except as a last resort of external control. Rules and consequences should be established and applied in an agreed-on manner, and above all, should be explained (this is what really educates and produces competence). It is necessary to express the principles, reasons, values, meaning and importance of the behavioral guideline that we are applying, and to have dialogue about them with our students or children. The effort involved, and even sacrifice, that many self-regulation behaviors involve, should also

be discussed. It is essential that there is a relationship of affection and trust. This is what gives us influence and power of persuasion in our advice.
3. *Regulatory habits.* Self-regulation takes shape in one's habits. This meta-skill requires practice in order to be established as a habit. Good habits, in turn, reinforce this meta-skill, by allowing it to be continuously in use.

Family and School Contexts That Do Not Contribute Toward Regulation (Non-regulatory External Contexts)

1. *Ambivalent family context.* Characterized by an environment lacking in guidelines, permissive, with unspecified limits or rules, and few control contingencies that offer external regulation. Consequently, this environment has been called *laisser-faire* (Fuentes et al., 2015). It is assumed that each member of the family must self-regulate, and therefore, external help from outward signals or rules is not needed. All the weight falls on the individual member's own self-regulation.
2. *Learning by trial and error is reinforced.* Behavioral initiative and learning by experience, discovery, and trial and error behaviors, are explicitly acknowledged and reinforced, meaning that behavioral excesses and deficits are accepted de facto. In the case of COVID-19, for example, parents will not remind or promote self-protection rules (mask use) or health rules (not attending mass events), but young people must make their own decisions whether to do so or not, according to their own level of self-regulation and competence regarding the problem.

Broken home environments, where parents are separated or absent, often tend toward this environmental design. Sometimes it is interpreted as a compromise, in order to alleviate and avoid conflict between parental rules that contradict each other. This encourages behavioral excesses and deficits, especially at ages where external regulation is necessary, such as adolescence and youth.

Family and School Contexts That Promote Dysregulation (Dysregulatory External Contexts)

1. *Modeling behavioral excesses and deficits as a dysregulating factor.* When people are exposed to behavioral models of excesses or deficits, and such inadequate models are vicariously reinforced by the context, this increases their probability of being reproduced (Bandura, 1971). It is thus highly likely that inadequate habits and behaviors become established. Let us imagine a family where, during lockdown, the parents' cope inadequately with the anxiety that this situation causes them by behavioral excess (excessive drinking, eating, and TV watching) or behavioral deficit (daily walking is discontinued and regular work hours are not kept). Through modeling and molding (intermittent social reinforcement), such behaviors promote coping strategies in their children that are also based on excesses or deficits, and not on self-regulation. In the case of families with divorced parents who have opposing childraising criteria, this explicitly contradictory model gives way to an alternation of contingencies applied by the two parents with their children.
   Another situation that induces dysregulation, for example, is when a child goes out without a mask and the parent applies social reinforcement, using dysregulatory social comments and attention reinforcement: "That's the way, son, this mask stuff is for fags," "let *them* be the ones to wear them," etc.
2. *Excessive control as a dysregulating factor*. Researchers have consistently found results showing that high levels of parental psychological control predict high levels of internalizing and externalizing problems in adolescents (Barber et al., 1994, 2005, 2012; Barber, 1996). One study longitudinally examined two potential mediators (negative emotional reactions and psychological reactance) of the link between parental psychological control and internalizing outcomes (i.e., depressive symptoms) and externalizing outcomes (i.e., antisocial behavior; Laird and Frazer, 2020). Psychological control seems to involve two concurrent processes: (a) the observable behaviors exhibited by the parents (e.g., telling the child how to think), and (b) the emotional (e.g., feeling controlled or intrusive control). Psychological, emotional and behavioral reactions, and internalizing /externalizing behavior may represent stable patterns similar to traits and motivational responses (e.g., compliance or resistance) exhibited by the adolescent. Two potential reactions to experiencing psychological control are of particular interest:
   The first involves *feeling frustrated*, controlled, or invaded by the parent's behavior. This construct has been labeled in previous work as negative emotional reaction and is similar to the need for frustration as operationalized by adolescents experience high levels of behavioral and psychological control as excess control. The adolescent is likely to feel frustrated, controlled or invaded by parental behavior and these emotional reactions can be expressed through internalizing or externalizing symptoms.
   The second, *psychological reactance* (Brehm, 1966), is defined as a "motivational state that is supposed to occur when a freedom is eliminated or threatened with elimination" (Brehm and Brehm, 1981, p. 37). Reactance is an unpleasant arousal in response to a threat or loss of freedom, motivating individuals to act to restore autonomy (Seltzer, 1983; Crawford et al., 2002; Steindl et al., 2015). Psychological control includes both external and internal threats that can produce psychological reactance. Psychological control poses an external threat by restricting a child's behavior. And when the need for relatedness conflicts with the need for autonomy, there is an internal threat, because the child is forced to prioritize the satisfaction of one need over the other. Fulfilling the psychologically controlling parent satisfies the need for kinship while not meeting the need for autonomy, but resisting the psychological controlling parent may satisfy the child's needs for autonomy at the expense of the child's need for kinship. Reactance can produce internalizing

symptoms when the child responds to internal threats, or externalizing symptoms when the child responds to external threats.

In the Socio-Community Educational Sphere

Externally Regulatory Context

1. *Clear, precise rules have been adopted by the community (antecedent variable) as an external regulatory factor.* All citizens have been informed of the rules, which are clear, unambiguous and promote self-regulation. They are based on rational arguments, with true, objective information. They are adopted and internalized by the population: they are necessary, they create expectations of control, and have value because they are appropriate to the context (Silvia, 2005). Rules lead to positive and negative consequences (and there is high perceived likelihood of contingency).
2. *Correct, preventive behavioral modeling (antecedent variable) as an external regulatory factor.* In this context, adequate behaviors to be followed are shown publicly and modeled using psychologically meaningful models for the different ages and types of persons. In other words, external regulatory signals are designed that promote personal self-regulation. These models create success expectations and values of attainment that result in adequate behavior and commitment to prevention (expectancy-value model; Pekrun, 2007). Dysregulatory behaviors are not publicized or modeled, and news that predisposes dysregulatory behaviors is not broadcast.
3. *Competent citizens (educational level of competence variable).* In this context, the other citizens that one observes have an essential role; since they are competent, they become regulatory agents and promote regulation in their peers. We must not forget that learning by social modeling is especially effective among age peers, who have influence and impact value as significant models of identification (see the Social Learning Theory; Bandura, 1971). In other words, educated, competent persons become – in themselves – agents of external regulation for others, through social modeling. The group of friends and peers at each age level would be essential for this effect, for example, among adolescent citizens, young university students, and adults, especially when they perceive themselves to be non-risk groups.
4. *Recognized, reasonable contingencies have been adopted by the community (consequent variables).* In this type of context, the citizens share the contingencies and participate in their application. Consequently, there is a high probability that the foreseen consequences or contingencies are applied; citizens are involved and exercise hetero-regulation --and if applicable, behavioral hetero-control. In communities or cultures with a high sense of social discipline and shared co-responsibility, it is easier to create an effective regulatory environment design (Veling et al., 2008; Camacho et al., 2020).

Non-regulatory Context (No Externally Induced Regulation)

1. No clear, precise rules that have been adopted by the community (antecedent variable) as an external regulatory factor, or rules are ambiguous. People are told to apply restrictions with ambiguous criteria or depend on their own criteria. The SRL vs. ERL theory predicts that this context requires more regulatory effort on the part of citizens. For example, if a person goes out and finds people who wear masks and people who do not, that person must decide whether to wear one based on their own criteria. The effort is even greater if there is no expectation of external contingencies from wearing or not wearing a mask.
2. Preventive behavioral modeling (antecedent variable), as an external regulatory factor, is confusing. Given that some people follow the rules and others do not, it is up to one's own criteria to follow the behavior of certain models or others. If a person possesses psychological factors and personal characteristics that predispose them to risk, they are more likely to make an inadequate choice from the preventive point of view.
3. Level of competence in citizens (educational level of competence variable), is medium or low. The educational level or level of training for an emergency or pandemic of these characteristics is low or medium. This means that little knowledge of the facts, principles, skills, meta-skills, attitudes, values and habits needed for coping with this health emergency situation. Incompetent persons become inadequate elements of external regulation for others, by their modeling and social molding (Bandura, 1971).
4. No recognized, reasonable contingencies have been adopted by the community (consequent variables), nor are they perceived as likely. In this type of context, citizens perceive an absence of external contingencies, and they do not have the training to self-apply contingencies in a self-regulating way. In this case, the laisser-faire model prevails at the community level. Behavior compliance or noncompliance is left to the criteria of personal self-regulation. This means greater personal regulatory effort, given that the external context is not ordered in a regulatory way.

Dysregulatory Context (Externally Induced Dysregulation)

1. *Clear, precise rules that encourage dysregulation (antecedent variable) become a dysregulating factor.* Creation of expectations and values (motivation) is toward transgression, or contrary to prevention rules, in certain more manipulable groups characterized by reactance or psychological needs (adolescents, young people, or adults without health competence). This can be observed in news reports of parties, crowds and big events without the use of masks, etc. The most extreme case of external dysregulation can be illustrated by the authorities expressly encouraging people to not wear masks as a sign of "personal freedom" or to attend dangerous events to show their commitment to a "noble cause."

2. *Dysregulatory behavioral modeling is very explicit and powerful (antecedent variable).* Social learning theory clearly explains that social pressure can effectively achieve changes in one's own criteria, even to an opposite direction. This is especially important in human developmental periods when peer pressure is greater. If a young person's friends all send him or her messages to go to a mask-free party for fun, the chances increase that the young person will end up carrying out this dysregulatory behavior.
3. *Incompetent citizens (educational level of competence variable).* The educational level or level of training for an emergency or pandemic of these characteristics is very low, making the population more manipulable when presented with possible dysregulatory messages from their leaders. The absence of objective information, consolidated principles or personal strengths, lack of self-regulation, risk habits and maladjusted values make dysregulatory behavior very likely.
4. *The immediate contingencies that the subject receives are very clear and in favor of dysregulation (consequent variables).* If I do not go to the mask-free fun party, or do not go to the bar with my friends to drink and have a good time, I may face two undesired consequences: (1) social punishment from peers, with degrading comments on social networks or bullying within the group and (2) loss of the reinforcement and fun of the situation itself. Consequently, a high level of general competence and particularly of self-regulation is needed to be able to face these powerful immediate contingencies of a dysregulating nature.
5. *Psychological reactance of the person.* Previus research have reported that the threats of the COVID-19 pandemic and the subsequent restrictions to people's freedom, social interaction, and closing of workplaces and shops have provoked public psychological reactance. Others research develops and demonstrates a conceptual framework that corroborates two bipolar behavioral results from psychological reactance in consumers: freedom of choice, satisfaction and resistance to persuasion. Anticipation of worry and confidence in the government positively moderated these relations.

Research indicates that certain language characteristics seem to evoke the perception that free behavior may be limited, provoking psychological reactance. In particular, language that is dogmatic, sometimes called *controlling* (Miller et al., 2007) or *explicit* (Grandpre et al., 2003), provokes reactance. As an illustration, Quick and Stephenson (2008) showed that *dogmatic messages* were perceived as more threatening, which provoked reactance, anger and unfavorable thoughts. Dogmatic messages include the following: imperatives (like "must" and "need"), absolute claims ("it cannot be denied that…" or "This problem is extremely serious"), disregard toward other perspectives ("Any reasonable person would agree that…"), and threatening warnings instead of impartial, objective information (Bushman, 1998). By contrast, messages that are less dogmatic do not provoke this sequence of reactions. Such messages are more likely to include the following: allusions to choice, like "You have the opportunity to…" or "It is up to you to choose…"; qualified statements, like "There is certain evidence that…" or "This problem is rather serious"; and objective and impartial information (Bushman, 1998). They avoid imperatives and derisory language. Many other studies have also confirmed that dogmatic language can promote reactance. For example, several studies have demonstrated that dogmatic language intended to reduce the consumption of alcohol provoked reactance (for example, Rains and Turner, 2007). Quick and Stephenson (2008) also showed that vivid language, where perceptual characteristics are described graphically, can also provoke a sensation of threat, and consequently, psychological reactance. Furthermore, for people who report high levels of reactance to *sensation-seeking traits*, dogmatic language was especially prone to promote reactance in the case of a vivid rather than pallid message.

Individual differences. Recent studies indicate that sensitivity to reactance varies from one individual to another. Dowd et al. (1994), for example, showed that persons who embrace autonomy and exhibit denial, dominance, independence, and mistrust are more inclined to experience psychological reactance. These findings are in alignment with Burgoon et al. (2002), who claimed that reactance would be more generalized in individuals who seek autonomy and feel that they are sufficiently competent and informed to choose their own course of action. People who are not especially sensitive to infringement on their freedom are more receptive to more directive or dogmatic persons. For example, Karno and Longabaugh (2005) carried out a study on clients who seek support for correcting their alcoholism. Clients who exhibited trait reactance were less prone to reduce their alcohol use when their counselors approached them with directives, initiated topics, communicated facts, interpreted comments, addressed resistance and formulated the main questions, instead of less directive approaches. However, clients that showed low levels of trait reactance changed their behavior even when the counselors were directive.

Physical space. Besides verbal communication, physical characteristics of an environment can also provoke a form of reactance, as Levav and Zhu (2009) uphold. For example, when people feel that their personal space is limited, they seem to demonstrate certain manifestations of reactance. In particular, they tend to select little-known or unusual products, demonstrating their independence through such selections. This search for independence may be prompted by reactance. When *physical space is limited,* individuals tend to feel stifled. As a consequence, they seek independence, restoring freedom by seeking variety.

CONCLUSION

The Covid-19 Behavioral Emergency in the Spheres of Health, Medicine-Biology and Educational Psychology

As the WHO claims, COVID-19 is an emergency in the health and medical-biological spheres. While the virus spreads at a fast rate, we have yet to fully understand its configuration,

functionality, and structure. We are only in the early stages of learning how to provide medical care at all levels, whether preventive (vaccines) or treatment (pharmacological, ventilators, etc.). Worldwide growth of the pandemic continues to be steep.

Unlike certain classic diseases, in this case, the individual can play a more active role in controlling the development of COVID-19. Psychological and social/behavioral aspects are clearly central in its development and proliferation. For example, research has identified the individual's self-regulation as a critical variable in a person's self-care and social habits, as well as treatment adherence. Thus, a person's behaviors in response to the crisis may be classified as regulatory (adequate), nonregulatory (doing nothing), or dysregulatory (doing the opposite of what is recommended). Another psychological variable of proven importance is coping strategies, used for managing anxiety and the stress provoked by situations with many unknowns. While these variables pertain to the individual, the context may also play an important role to encourage or discourage their presence.

For this reason, the *psychoeducational context* may also be regulatory, nonregulatory or dysregulatory. A regulatory external context would encourage individuals to self-regulate (appropriate messages and rules, social modeling, external monitoring, etc.). In the spread of COVID-19, this type of context predicts a more flattened curve of contagion, allowing the healthcare system the chance to respond. A nonregulatory context neither favors nor discourages self-regulation, it is left to the individual. Mathematical models of the unhindered spread of the epidemic point to a platykurtic curve that eventually brings the healthcare system to collapse. However, a dysregulatory context is also possible. This type of context encourages individual behavior that is directly opposed to what is appropriate. The epidemiological consequences of such behavior would be devastating, with contagion rapidly exploding (Zhu et al., 2020).

Psychology, as a behavioral science, is devoted to evaluating and intervening in such behavioral variables (psychoeducational and psychosocial). It is urgent that we recognize and address the psychosocial component of health-related issues, in addition to their medical-biological component. We must understand and act on behavioral, personal and contextual aspects, especially in critical situations such as the pandemic. An integrated, bio-psycho (educational)-social model (de la Fuente, 2020b) must underlie collaboration from the fields of Medicine, Biology and Psychology.

AUTHOR CONTRIBUTIONS

JF: design and initial writing. DK, MD, and YK: review and final writing. All authors contributed to the article and approved the submitted version.

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High Trait Self-Control and Low Boredom Proneness Help COVID-19 Homeschoolers

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In response to the coronavirus disease 2019 (COVID-19) schools around the world have been closed to protect against the spread of coronavirus. In several countries, homeschooling has been introduced to replace classroom schooling. With a focus on individual differences, the present study examined 138 schoolers (age range = 6 to 21 years) regarding their self-control and boredom proneness. The results showed that both traits were important in predicting adherence to homeschooling. Schoolers with higher levels of self-control perceived homeschooling as less difficult, which in turn increased homeschooling adherence. In contrast, schoolers with higher levels of boredom proneness perceived homeschooling as more difficult, which in turn reduced homeschooling adherence. These results partially hold when it comes to studying in the classroom. However, boredom threatened adherence only in the homeschooling context. Our results indicate that boredom proneness is a critical construct to consider when educational systems switch to homeschooling during a pandemic.

Keywords: COVID-19, homeschooling, boredom, self-control, self-regulation

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INTRODUCTION

> *"And the faculty of voluntarily bringing back a wandering attention, over and over again, is the very root of judgment, character, and will. No one is compos sui [master of himself] if he have it not. An education which should improve this faculty would be the education per excellence." William James, The Principles of Psychology (1980).*

The coronavirus disease 2019 (COVID-19) pandemic represents a global crisis affecting nearly all countries and every sector of human life including health, economy, and education. Current theorizing highlights the relevance of social and behavioral sciences in order to contain the spread of the virus (Van Bavel et al., 2020). To slow the spread of COVID-19, countries have employed various social distancing (or physical distancing) measures. One frequently employed social distancing measure is the closing of schools and educational institutions. In March 2020, such measures were employed by 102 countries, with the effect of almost 900 million children and adolescents being asked to switch to homeschooling (Burn, 2020). This forced COVID-19 homeschooling should not be mistaken for classical homeschooling, which has emerged since the late 1970s as a dedicated educational approach (Jolly and Matthews, 2020).

Contrary to classical homeschooling, the current situation was imposed to schoolers, parents, and teachers, and there was a great variation in terms of restrictions and in terms of teaching activities in general (e.g., online teaching, homeschooling, self-organized study; Thorell et al., 2020). As it is likely that homeschooling presents schoolers with challenges that differ from those that they experience during classroom schooling, it is crucial to investigate the role of individual differences in explaining children's struggles and successes in dealing with this change in educational format. Specifically, given the reduction in external structure, we expect homeschooling to present a self-regulatory challenge. In turn, we expect personality traits that affect how people deal with such challenges to be of particular importance during this time. Boredom proneness and self-control are two such traits. Here, we draw upon recent functional theorizing on boredom and self-control (Wolff and Martarelli, 2020) to investigate the role of boredom proneness and trait self-control in how schoolers cope with the challenges of homeschooling in the current situation. Our approach can help in identifying schoolers that might struggle with homeschooling and enable the development of strategies that enhance homeschooling adherence.

Self-Control and Boredom

Self-control and boredom are closely linked: High self-control has shown to be associated with low boredom proneness (Isacescu et al., 2017; Mugon et al., 2018; Bieleke et al., 2020b; Boylan et al., 2020; Wolff et al., 2020b). In addition, boredom seems to be related with poor cognitive, physical and emotional self-regulation (Isacescu et al., 2017; Wolff et al., 2020a) and while high trait self-control is rather consistently linked with positive outcomes (Moffitt et al., 2011), boredom proneness is linked with mostly negative outcomes (Eastwood et al., 2012). Based on this inverse relationship on the trait level, recent theoretical work suggests that the sensation of boredom and the sensation that accompanies the application of self-control (i.e., effort) both act as functional signals that help people orient their behavior (Wolff and Martarelli, 2020), which has been supported by empirical research (Bieleke et al., 2020a). According to this perspective, the perception of effort that arises when self-control is applied signals the costs of a current activity (e.g., the cost of foregoing the gratification of surfing the internet and to do the math assignment instead) and if the cost outweighs the activity's benefit, then this activity is terminated (Kurzban et al., 2013). Within this line of reasoning, boredom is understood as a signal that the task at hand is not worth pursuing (e.g., completing the math assignment) and that there might be other more rewarding activities (e.g., surfing the internet). Thus, boredom is a strong driver of behavioral change (Geana et al., 2016; Gomez-Ramirez and Costa, 2017; Bench and Lench, 2019; Danckert, 2019). To resist the boredom-induced drive for change, self-control is required (Milyavskaya et al., 2019), thereby making boredom an additional self-control demand, that schoolers are likely to have to deal with during homeschooling.

Self-control can be described as the effort individuals exert to overcome predominant responses to reach a goal (Shenhav et al., 2013) and has been found to emerge early in life and to continue to develop until adulthood (Pan and Zhu, 2018). Self-control is required in many situations and higher levels of self-control have been shown to be associated with several positive outcomes including transition to school and academic achievement (Tangney et al., 2004; Welsh et al., 2010; Zhu et al., 2016; Lindner et al., 2018; Martarelli et al., 2018). Given the key role of self-control in the educational context, it is plausible that high self-control helps schooler to better deal with specific demands of homeschooling (Blume et al., 2020). Indeed, studying in a more unstructured context such as at home where other (more rewarding) activities are within the reach of schoolers, possibly requires more effortful control than studying in a classroom. Thus, the role of self-control might be even more pronounced during homeschooling than in the classroom setting. In turn, to keep on studying while in home confinement might be particularly challenging for schoolers with low levels of self-control.

Boredom has been defined as the inability to successfully engage attention with the outer world or inner worlds (Eastwood et al., 2012) and has been associated with several negative outcomes also in the academic context (Bearden et al., 1989; Pekrun et al., 2010). While the detrimental effects of boredom in the classroom might partially be relieved by the teacher (e.g., by changing the task at hand, by redirecting attention to learning requirements, and more generally by highlighting the *meaning* of studying, or by adapting the *difficulty* of the learning material; Westgate and Wilson, 2018), homeschoolers might be challenged by several other opportunities (e.g., surfing the internet) and the experience of boredom will enhance the saliency of these other more rewarding activities (Elhai et al., 2017). Moreover, being in an environment that offers many alternative activities and not being supposed to engage with these activities is perceived as particularly boring (Struk et al., 2020). Thus, we predict that boredom prone schoolers will find it more difficult to study in homeschooling and some will mitigate boredom by engaging in alternative activities.

The Present Study

The rapid and exponential spread of the coronavirus across the world has generated substantial economic and social disruptions that have affected people's lives and well-being. For schoolers, parents and teachers school closures and the associated homeschooling has been a new challenge. The schoolers' perspective quickly gets out of focus when discussing about homeschooling. Therefore, we developed a short, child-friendly questionnaire, which should give information about the experiences of schoolers. Based on recent theorizing about self-control and boredom (Martarelli and Wolff, 2020; Wolff and Martarelli, 2020) we aimed to investigate the role of trait self-control and boredom proneness in the perceived difficulty of homeschooling and in the adherence to homeschooling. We expect that schoolers high in self-control will find it easier to study in homeschooling, which in turn should increase homeschooling adherence. Further, we expect that schoolers high in trait boredom proneness find it more difficult to study in homeschooling, which in turn should decrease homeschooling adherence. We expect trait self-control and boredom proneness

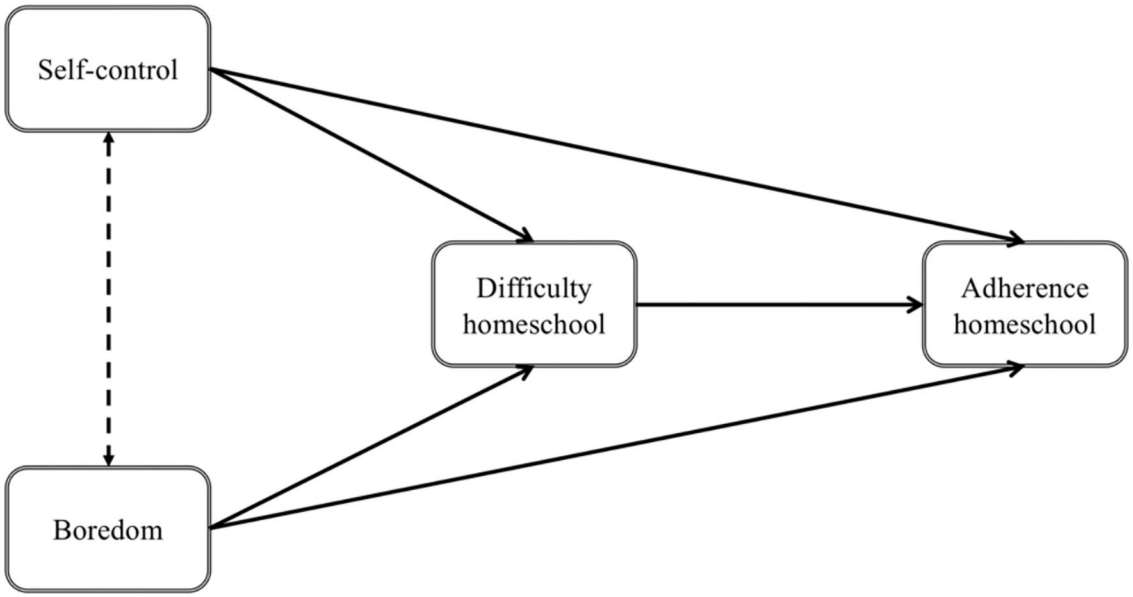

FIGURE 1 | Conceptual model in which the effects of self-control and boredom on adherence are mediated by the perceived difficulty of homeschooling.

to have direct effects on homeschooling adherence. Finally, we expect similar relationships between these variables in the classroom; however, because of how classroom lectures are structured these relationships should be less pronounced. **Figure 1** summarizes the proposed mediation model.

MATERIALS AND METHODS

Participants

One hundred thirty-eight schoolers (58.7% female) took part to the study. All of them were attending school (44.9% primary school, 19.6% secondary school, 32.6% college, 2.9% other) and in homeschooling when filling in the questionnaire (end of April 2020). The age range was between 6 and 21 years and the vast majority of the participating schoolers lived in Switzerland (98.6%). More than half of the participants were French-speaking (55.1%), the remaining participants were German-speaking. About half of the sample reported their parents held a university degree (49.28%). The schoolers who participated in this study were contacted via their parents, who first gave parental consent. The local ethics committee approved the study, which was conducted in accordance with the Declaration of Helsinki.

Procedure

Schoolers completed the questionnaire online, using the freely available open source software Limesurvey (www.limesurvey.org). All schoolers gave written informed consent, and they could ask parents for help, if needed. The study lasted on average 10 min and we used items with 5-point Likert scales throughout the study (1 = *do not agree at all*, 5 = *fully agree*) with the exception of demographics.

First, *adherence to study in homeschooling* was assessed with one item ("At home, I reliably work on the tasks that the teacher gives me") and *perceived difficulty of homeschooling* was measured with a set of three items ("I find it hard to study in homeschooling," "I find it boring to study in homeschooling," "I have no desire to study in homeschooling"). Next, the same questions were asked for the classroom schooling context before the COVID-19 pandemic. We assessed *adherence to study in the classroom* ("In the classroom I reliably work on the tasks that the teacher gives me") and *perceived difficulty of studying in the classroom* with a set of three items ("I find it hard to study in the classroom," "I find it boring to study in the classroom," "I have no desire to study in the classroom").

Subsequently, schoolers worked on five items taken from the German short version of the *Self-Control* Scale (Tangney et al., 2004; Bertrams and Dickhäuser, 2009), which measures individuals' general ability to regulate themselves (e.g., "Sometimes I can't stop myself from doing something, even if I know it is wrong"), and four questions taken from the German Short *Boredom Proneness* Scale (Struk et al., 2017; Martarelli et al., 2020), which measures individuals' boredom proneness (e.g., "I find it hard, to entertain myself"). The wording of items was adapted to children and is reported in the **Supplementary Material**. Finally, schoolers reported demographics, including gender, age, residence, attended school, and parents' educational level.

RESULTS

To test the proposed model (**Figure 1**) we used *R* (R core Team, 2020) with the functionalities of the *lavaan* package (Rosseel et al., 2018). The standard errors for the defined parameters were computed with bias-corrected bootstrap method (1,000

TABLE 1 | Descriptive summary of measures.

Measure	Mean (SD)	Skewness	Kurtosis	Alpha	Omega
Self-control	3.23 (0.81)	0.13	−0.82	0.709	0.710
Boredom	2.13 (0.87)	0.77	0.29	0.790	0.796
Difficulty homeschool	2.95 (1.07)	−0.15	−0.82	0.773	0.776
Difficulty classroom	2.32 (1.03)	0.56	−0.51	0.850	0.851
Adherence homeschool	3.84 (1.19)	−0.94	0.07		
Adherence classroom	4.36 (0.76)	−1.32	2.40		

N = 138.

bootstrap repetitions). The R code to reproduce analyses as well as the data set is available on OSF at https://osf.io/32rwe/. Descriptive statistics were computed with jamovi version 1.1.9.0 (The jamovi project, 2020) and with JASP version 0.12.2 (JASP Team, 2020).

Descriptive Statistics

Adherence to study in homeschooling during the COVID-19 situation was relatively high (mean of 3.84 out of 5) but significantly lower than adherence to study in the classroom (mean of 4.36 out of 5), paired-samples *t*-test $t_{(137)} = 5.70$, $p < .001$, Cohen's $dz = 0.48$. The internal consistency of the scales was good, skewness and kurtosis were low (see **Table 1**).

With regard to preliminary correlation analyses, **Table 2** shows significant correlations between our predictor, mediator and outcome variables. The correlations were in the expected direction, and stronger in the homeschooling context when compared to the classroom.

Homeschooling Model

The unstandardized and standardized path coefficients, standard errors, and *p*-values of the homeschooling model can be found in **Table 3** and are depicted in **Figure 2**. Individual differences in self-control and boredom influenced the perceived difficulty of homeschooling, self-control: $b = -0.550$, $\beta = -0.417$, $SE = 0.106$, $p = < 0.001$; boredom: $b = 0.208$, $\beta = 0.170$, $SE = 0.109$, $p = 0.056$. Both variables together explained 26.2% of variance in perceived difficulty. The difficulty of homeschooling in turn negatively influenced the adherence to homeschooling, $b = -0.252$, $\beta = -0.227$, $SE = 0.078$, $p = 0.001$. Individual differences in self-control and boredom also influenced the adherence to homeschooling, self-control: $b = 0.624$, $\beta = 0.426$, $SE = 0.114$, $p = < 0.001$; boredom: $b = -0.192$, $\beta = -0.142$, $SE = 0.111$, $p = 0.083$. For self-control not only the direct effect, but also the indirect effect, $b = 0.139$, $\beta = 0.095$, $SE = 0.052$, $p = 0.007$, and the total effect, $b = 0.762$, $\beta = 0.521$, $SE = 0.110$, $p = < 0.001$, were significant. The indirect effect of boredom on adherence was not significant, $b = -0.052$, $\beta = -0.039$, $SE = 0.033$, $p = 0.114$, while the total effect turned out to be significant, $b = -0.245$, $\beta = -0.180$, $SE = 0.114$, $p = 0.031$. The model explained 42.0% of variance in adherence to homeschooling.

We additionally estimated the model including age and gender. Gender (coded as 0 for male and 1 for female) had a significant impact on self-control, $b = 0.290$, $\beta = 0.177$, $SE = 0.124$, $p = 0.020$. Age had a significant impact on self-control, $b = -0.075$, $\beta = -0.373$, $SE = 0.017$, $p < 0.001$, on boredom, $b = 0.070$, $\beta = 0.319$, $SE = 0.018$, $p < 0.001$, and on adherence to homeschooling, $b = -0.041$, $\beta = -0.139$, $SE = 0.021$, $p = 0.049$. Gender and age did not change the other results (no change in accepting or rejecting the null hypotheses).

Classroom Model

The unstandardized and standardized path coefficients, standard errors and *p*-values of the classroom model can be found in **Table 4** and are depicted in **Figure 3**. Individual differences in self-control and boredom influenced the perceived difficulty of studying in the classroom, self-control: $b = -0.436$, $\beta = -0.342$, $SE = 0.100$, $p = < 0.001$; boredom: $b = 0.205$, $\beta = 0.174$, $SE = 0.101$, $p = 0.043$. Both variables together explained 19.6% of variance in perceived difficulty. However, the difficulty of studying in the classroom did not influence the adherence to studying in the classroom, $b = -0.098$, $\beta = -0.132$, $SE = 0.071$, $p = 0.167$. The direct effect of self-control on adherence to studying in the classroom, $b = 0.254$, $\beta = 0.270$, $SE = 0.093$, $p = 0.006$ turned out to be significant, while the indirect effect was not significant, $b = -0.020$, $\beta = -0.023$, $SE = 0.019$, $p = 0.284$. The total effect of self-control on adherence was significant, $b = 0.297$, $\beta = 315$, $SE = 0.081$, $p = < 0.001$. The direct, indirect and total effect of boredom on adherence to studying in the classroom were not significant ($ps > 0.284$). The model explained 15.3% of variance in adherence to studying in the classroom.

We additionally estimated the model including age and gender. Gender (coded as 0 for male and 1 for female) had a significant impact on self-control, $b = 0.290$, $\beta = 0.177$, $SE = 0.124$, $p = 0.020$. Age had a significant impact on self-control, $b = -0.075$, $\beta = -0.373$, $SE = 0.017$, $p < 0.001$, on boredom, $b = 0.070$, $\beta = 0.319$, $SE = 0.018$, $p < 0.001$, and on adherence to studying in the classroom, $b = -0.038$, $\beta = -0.198$, $SE = 0.019$, $p = 0.042$. When adjusting for age and gender, we found no changes in the pattern of results with one exception: the direct effect of self-control just missed significance, $b = 0.198$, $\beta = 0.210$, $SE = 0.105$, $p = 0.060$.

DISCUSSION

Here, we show that both trait self-control and boredom proneness predict adherence to homeschooling (according to the significance of their total effects and the model's

TABLE 2 | Correlations of measures.

		Self-control	Boredom	Difficulty	Adherence
Self-control	Pearson's *r*	–	−0.413	−0.414	0.360
	p-value	–	<0.001	<0.001	<0.001
Boredom	Pearson's *r*	−0.413	–	0.315	−0.238
	p-value	<0.001	–	<0.001	0.005
Difficulty	Pearson's *r*	−0.487	0.342	–	−0.270
	p-value	<0.001	<0.001	–	0.001
Adherence	Pearson's *r*	0.595	−0.395	−0.483	–
	p-value	<0.001	<0.001	<0.001	–

N = 138. Correlations and significance for the homeschooling model are reported in the lower part of the table and correlations for the classroom model are reported in the upper part of the table.

TABLE 3 | Homeschooling Model.

Type	Effect	Estimate	Std. Err	95% C.I. lower	95% C.I. upper	*z*-value	*p*-value	Std. estimate
Component	Difficulty ⇒ Adherence	−0.252	0.078	−0.406	−0.096	−3.241	0.001	−0.227
Direct	Self-control ⇒ Adherence	0.624	0.114	0.387	0.842	5.470	<0.001	0.426
Direct	Boredom ⇒ Adherence	−0.192	0.111	−0.415	0.014	−1.734	0.083	−0.142
Component	Self-control ⇒ Difficulty	−0.550	0.106	−0.755	−0.340	−5.200	<0.001	−0.417
Component	Boredom ⇒ Difficulty	0.208	0.109	0.003	0.442	1.910	0.056	0.170
Covariance	Boredom ∼∼ self-control	−0.290	0.058	−0.415	−0.181	−5.014	<0.001	−0.413
Variance	Adherence	0.810	0.109	0.634	1.077	7.398	<0.001	0.580
Variance	Difficulty	0.836	0.087	0.679	1.023	9.655	<0.001	0.738
Variance	Self-control	0.652	0.061	0.546	0.787	10.736	<0.001	1.000
Variance	Boredom	0.758	0.098	0.579	0.979	7.752	<0.001	1.000
Indirect	Self-control ⇒ Difficulty ⇒ Adherence	0.139	0.052	0.056	0.263	2.686	0.007	0.095
Indirect	Boredom ⇒ Difficulty ⇒ Adherence	−0.052	0.033	−0.145	−0.005	−1.581	0.114	−0.039
Total	Self-control ⇒ Adherence	0.762	0.110	0.536	0.972	6.935	<0.001	0.521
Total	Boredom ⇒ Adherence	−0.245	0.114	−0.471	−0.027	−2.153	0.031	−0.180

N = 138. Standard errors were computed with bias-corrected bootstrap method (1,000 bootstrap repetitions).

explained variance). Schoolers with higher levels of self-control perceived homeschooling as less difficult, which in turn increased homeschooling adherence. In contrast, schoolers with higher levels of boredom proneness found it more difficult to study in homeschooling (effect is significant at the 0.1 level) and showed less adherence to homeschooling (effect is significant at the 0.1 level). The same pattern of association partially occurred in the classroom context. Schoolers with higher levels of self-control perceived studying in the classroom as less difficult and showed an increase in adherence. However, boredom proneness did not threaten adherence in the classroom (direct, indirect and total effects of boredom turned out to be non-significant in the classroom model). Moreover, there was a large difference in explained variance (42.0% in the homeschooling model vs. 15.3% in the classroom model).

According to these results, schoolers with low levels of self-control and high levels of boredom proneness might be disadvantaged in a homeschooling setting. Generally these findings fit well with recent theoretical work ascribing a key role to self-control and boredom as guiding signals of goal-directed behavior (Wolff and Martarelli, 2020) and with recent empirical work showing a strong link between self-control and boredom (e.g., Isacescu et al., 2017). Thus, schoolers, who tend to get bored also tend to show low self-control and this structural combination could make the continuation of their education during a pandemic challenging.

In order to create equal educational opportunities, teachers, parents, and school principals should take boredom into account in the context of homeschooling during a pandemic. One possibility to reduce the detrimental effects of boredom on learning could be to create an environment conducive to learning. First, (more rewarding) behavioral alternatives that are not linked with studying should be removed. This suggestion builds upon a recent study of Struk et al. (2020) that investigated the impact of behavioral restrictions on boredom. The results showed that a room with no behavioral alternatives (when compared with a room containing several behavioral possibilities such as a computer with an open browser) was perceived as less boring by participants that were asked to entertain themselves

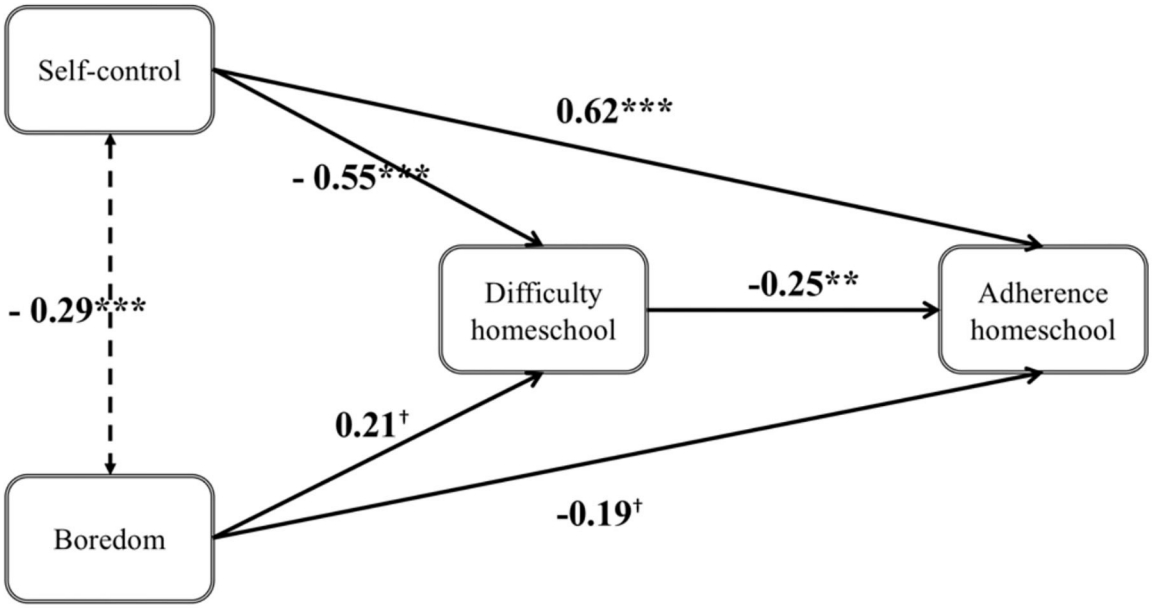

FIGURE 2 | Homeschooling model $N = 138$. Coefficients are unstandardized ***. Difference is significant at the 0.001 level (two-tailed) and **. Difference is significant at the 0.01 level (two-tailed) †. Difference is significant at the 0.1 level (two-tailed).

TABLE 4 | Classroom model.

Type	Effect	Estimate	Std. Err	95% C.I. lower	95% C.I. upper	z-value	p-value	Std. estimate
Component	Difficulty ⇒ Adherence	−0.098	0.071	−0.240	0.046	−1.381	0.167	−0.132
Direct	Self-control ⇒ Adherence	0.254	0.093	0.064	0.427	2.731	0.006	0.270
Direct	Boredom ⇒ Adherence	−0.074	0.096	−0.256	0.118	−0.776	0.438	−0.085
Component	Self-control ⇒ Difficulty	0.436	0.100	−0.628	−0.243	−4.357	<0.001	−0.342
Component	Boredom ⇒ Difficulty	0.205	0.101	0.004	0.406	2.027	0.043	0.174
Covariance	Boredom ∼∼ self-control	−0.290	0.058	−0.415	−0.181	−5.014	<0.001	−0.413
Variance	Adherence	0.490	0.091	0.352	0.726	5.378	<0.001	0.847
Variance	Difficulty	0.848	0.092	0.697	1.082	9.173	<0.001	0.804
Variance	Self-control	0.652	0.061	0.546	0.787	10.736	<0.001	1.000
Variance	Boredom	0.758	0.098	0.579	0.979	7.752	<0.001	1.000
Indirect	Self-control ⇒ Difficulty ⇒ Adherence	0.042	0.035	−0.014	0.124	1.225	0.221	0.045
Indirect	Boredom ⇒ Difficulty ⇒ Adherence	−0.020	0.019	−0.076	0.005	−1.072	0.284	−0.023
Total	Self-control ⇒ Adherence	0.297	0.081	0.131	0.445	3.669	<0.001	0.315
Total	Boredom ⇒ Adherence	−0.094	0.097	−0.278	0.103	−0.976	0.329	−0.108

N = 138. Standard errors were computed with bias-corrected bootstrap method (1,000 bootstrap repetitions).

with their thoughts. Moreover, participants in the room with behavioral alternatives more often engaged in these alternatives even though they were explicitly told not to do so. In other words, to mitigate boredom, they changed behavior (Struk et al., 2020). This behavioral pattern might also possibly occur in a homeschooling context. Thus, a learning environment that limits boredom could be achieved by proposing structured and diverse learning material, by using different learning modalities, and by reducing general distractions (e.g., putting distractions such as smartphones out of reach). Further, the difficulty of the learning material should be considered (Eastwood et al., 2012; Westgate and Wilson, 2018). By providing sufficient assistance, adapting the requirements or encouraging schoolers to seek for help, an under/overload can be prevented which in turn decreases the risk for a lack of adherence. Finally, boredom also arises as a consequence of lack of meaning (Van Tilburg and Igou, 2017; Westgate and Wilson, 2018). Thus, a further strategy might be to make homeschooling more meaningful and valuable.

Importantly, even in optimal environments (e.g., structured environment) people can still get bored. This is particularly true for boredom prone schoolers, who tend to experience boredom more frequently. Therefore, it would be crucial to equip schoolers

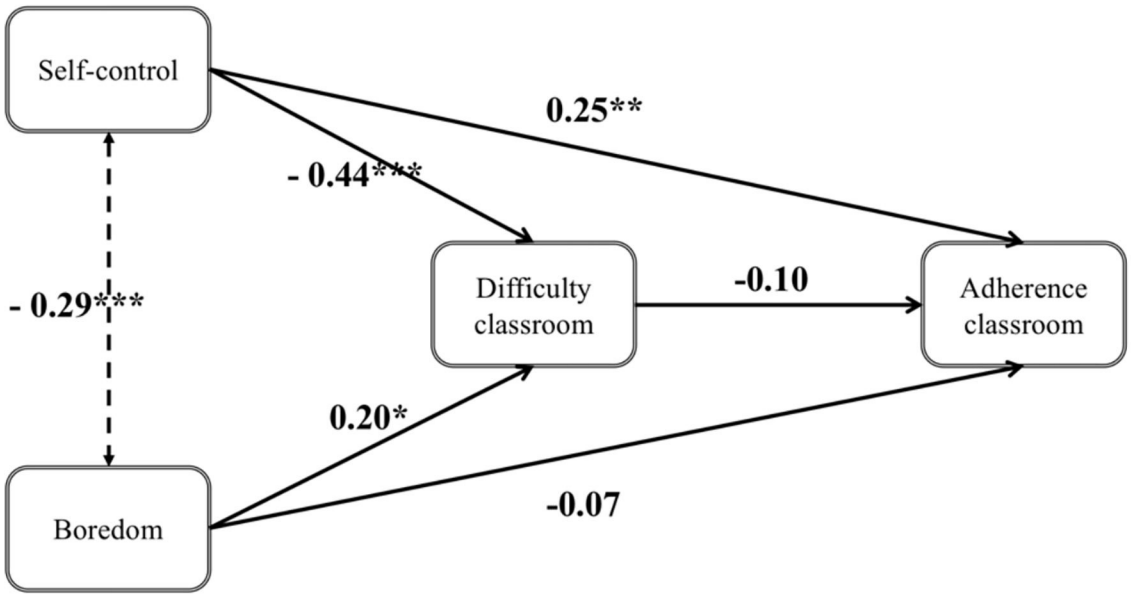

FIGURE 3 | Classroom model *N* = 138. Coefficients are unstandardized ***. Difference is significant at the 0.001 level (two-tailed) and **. Difference is significant at the 0.01 level (two-tailed).

with specific skills to recognize and cope with their boredom. One suggestion is, for e.g., to help schoolers to identify their individual "warning signs" of boredom (and of related constructs such as mind-wandering) and to encourage them to change activity by explicitly choosing the next activity, as for example to explore alternative learning material when bored with the task at hand. More generally, learning to recognize and use boredom in an adaptive manner might be useful for schoolers to redirect their attention to relevant external and/or internal information. This strategy should in turn also make homeschooling less self-control demanding.

There are limitations of the study that should be considered when interpreting the findings. One major limitation is that we used cross-sectional data, thus the temporal ordering of variables in the causal chain of mediation reflects theoretical considerations that do not necessarily correspond to how these effects unfold over time. For this reason, the estimated mediation effect is of correlational nature. Since correlations cannot offer insight into directionality of a relation between variables, it will be important for future research to carefully examine the directionality of the effect. Only then effective interventions can be implemented to improve homeschooling conditions. Furthermore, we worked with a small set of self-report measures, the sample size is also relatively small, and we recruited a convenience sample. Further research is needed to investigate other variables that are known to correlate with the variables measured here, such as self-efficacy or sense of agency (in terms of individual awareness of what one can do). Self-efficacy pertains to subjective expectations of being able to deal with situations that are novel and/or challenging on the basis of one's own competencies (Bandura, 1997). It is thus conceivable that self-efficacy would allow shedding additional light on the link between the perceived difficulty of homeschooling and adherence to homeschooling. Future research would benefit from investigating the generalizability in more detail using other methodologies (such as online experience sampling methods) and other samples, including different socio-cultural contexts.

Because boredom has been associated with numerous negative outcomes (Eastwood et al., 2012), it has a rather negative connotation. However, it has also been linked to positive outcomes such as creativity (Harris, 2000) and pro-social behavior (Van Tilburg and Igou, 2017). Boredom is a powerful motivator for negative and positive behaviors alike (Elpidorou, 2014, 2017). If correctly taken into account, boredom informs schoolers, that they are failing to pay attention and that a change in behavior is needed. One advantage of homeschooling (compared to traditional settings) might be the possible individualization of learning. Homeschoolers are more flexible and can thus more strongly regulate their way of learning if provided with the right support.

DATA AVAILABILITY STATEMENT

All relevant data are available on the Open Science Framework (https://osf.io/32rwe/).

ETHICS STATEMENT

The study was reviewed and approved by the ethics commission of the Swiss Distance University Institute. Written informed consent from the participants' legal guardian was not required

to participate in this online study in accordance with the institutional requirements.

AUTHOR CONTRIBUTIONS

CM, SP, MB, and WW contributed to conception and design of the study. SP and CM prepared the study and collected the data. CM performed the analyses and wrote the first draft of the manuscript. All authors discussed the results, contributed to the final manuscript and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.594256/full#supplementary-material

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COVID-19: Are School Counseling Services Ready? Students' Psychological Symptoms, School Counselors' Views, and Solutions

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The purpose of the current study was to investigate the effects of COVID-19 on high school students' psychological symptoms and to understand how ready counselors and school counseling services are based on the data we have. Therefore, this research is designed under two different studies: (A) Study 1: Effects of COVID-19 pandemic on students' psychological symptoms and (B) Study 2: Views and expectations of students and school counselors about school counseling services. The first study was a quantitative study and included 549 high school students (398 female, 151 male). A structural equation model (SEM) was created to examine the effects of COVID-19 pandemic on participants' psychological symptoms. The Impact of Event Scale-Revised (IES-R) scores showed that 107 (19.50%) individuals had a score of 50 and above pointing out that individuals in this group had severe impact of event/trauma symptomologies. The SEM analysis indicated that IES-R scores had a total effect of 0.79 on anxiety, 0.75 on depression, 0.74 on negative self-concept, 0.68 on somatization, and 0.66 on hostility scores. Furthermore, female students had significantly higher scores on anxiety, depression, negative self-concept, somatization, hostility, and impact of events variables than male students. Study 2 was a qualitative design and consisted of five school counselors and five students from different schools. The results indicated that students' difficulties during the coronavirus disease 2019 (COVID-19) outbreak were educational, cognitive, emotional, physiological, relational, technological, and related to routines. Academic, social, emotional, and behavioral issues came to the fore among the difficulties that can be experienced if students start face-to-face education. On the other hand, the school counselors listed that family relations, personal–social, emotional, and academic themes were the difficulties experienced by the students at the beginning of the COVID-19. In addition, when COVID-19 started, the services offered by school counselors were discussed under (1) services for the student, (2) services for the family, and (3) services for the teacher. Finally, according to the opinions of the school counselors, if students start face-to-face education, they may experience emotional, academic, and relational difficulties. In summary, it is vital that student personality services be prepared and implemented by school counseling services for schools based on the results.

Keywords: COVID-19, psychological symptoms, high school students, school counselors, counseling services

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INTRODUCTION

In December 2019, the Chinese government was stirred by the findings of unexplained lung infections in four people working at a seafood and live animal market in Wuhan and in people who visited this market at the time (Evren and Us, 2020). On January 7, 2020, it was determined that a new type of coronavirus [severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)] was the basis of this disease (Xu et al., 2020) and since then, this virus has been defined as coronavirus disease 2019 (COVID-19) (WHO, 2020a). The WHO has declared a pandemic on March 11, 2020, and the first case was diagnosed on the same day in Turkey as well.

In the fight against coronavirus, due to the fact that the coronavirus is very contagious and the vaccine, which is the most important strategy in preventing the disease, was not yet available, the rapid and most effective implementation of other measures has come to the fore (Çöl and Güneş, 2020). In this context, many additional precautions have been taken around the world. The precautions first started with the ban on entering and exiting the city of Wuhan and continued with travel bans, curfews, country-based quarantine announcements, state of emergency announcements, prohibition of public events, and social isolation (Ministry of Health T. R., 2020; WHO, 2020b). One of the most important precautions taken in this regard was the interruption of education in schools in order to prevent students from becoming infected (Ali and Alharbi, 2020). Distance learning was introduced at all K-12 schools and at universities in Turkey as in many countries in the world (Reimers, 2020). In fact, in the 2020–2021 academic year, face-to-face education started with first graders, eighth graders, and high school 12th grades, but with the rapid increase in the number of cases (2nd Wave), schools were closed again, and full-time distance education continued. In this context, planned sports activities and all kinds of scientific events and artistic activities were postponed or canceled [Türkiye Bilimler Akademisi (TÜBA), 2020].

During the COVID-19 pandemic, students' access to education and training activities through online platforms has increased the impact of the crisis situation experienced. Social/physical distance and other limitations can cause negative psychological situations such as anxiety and fear, and these can affect students' well-being (Özer, 2020; Wang et al., 2020). Students have been shown among the groups with the most psychological difficulties during this period (Cao et al., 2020; Güngör et al., 2020) because they had to take part in distance education activities without participating in any orientation process and adapt to this process without support. This has created a general disappointment in students (Shores, 2020). Due to the difficulties experienced after COVID-19, children had difficulties in adapting to the situation and experienced learning difficulties, and this increased their anxiety (Çaykuş and Mutlu Çaykuş, 2020). Schools not only provide educational services but also many other services to students (such as food/nutrition, health care, educational programs, and mental health services).

The COVID-19 pandemic negatively affected the mental health and social, emotional, psychological, and educational well-being of young people (Golberstein et al., 2020). When other research results are examined, it has been stated that schools have various effects that can help alleviate this process in outbreaks (Sadique et al., 2008; Cauchemez et al., 2009; Demir Öztürk et al., 2020). It is normal for outbreaks to cause anxiety and fear in society (Güngör et al., 2020), but the anxiety and fear caused by the pandemics may make it difficult for individuals to combat the results of the outbreak. Identifying and responding to factors associated with anxiety can reduce individuals' anxiety levels and contribute to combating the pandemic (Banerjee, 2020; Brooks et al., 2020). In other words, the pandemic has brought not only the risk of illness and death but also negative psychological impacts (Duan and Zhu, 2020; Guo et al., 2020). For example, fear of getting sick, fear of being alone at home and delay in education, fear of families' inability to pay their education fees due to loss of income, and watching negative content on social media negatively affected the mental health of students (Kernan, 2019; Cao et al., 2020; Güngör et al., 2020; Tönbül, 2020). Increasing level of fear leads to a decrease in individuals' levels of well-being and hope. In addition, quarantine practices can increase the stress level and cause emotional problems (Fardin, 2020; Naeem et al., 2020; Qiu et al., 2020). The pandemic increases the risks of permanent mental distress (Liu et al., 2020). In the study conducted by YoungMinds (2020), 83% of young participants reported that the COVID-19 pandemic had worsened preexisting mental health conditions due to the closing of schools, loss of routine, and limited social connections.

The intensity and frequency of behavioral, cognitive, and emotional responses of students during the COVID-19 period can be reduced by suggestions given to families, teachers, and mental health professionals; behavioral and adaptational problems can be prevented or eliminated. Social support not only reduces psychological pressure during pandemics but also changes attitude toward social support and seeking help (Bai et al., 2005; Dorado et al., 2016). In a study conducted by Al-Rabiaah et al. (2020) on students during the Middle East respiratory syndrome coronavirus (MERS-CoV) epidemic, it was emphasized that students were experiencing stress and needed psychological assistance in such epidemics. Therefore, the need for mental health professionals (e.g., professional counselors) arises after situations, such as pandemics, natural disasters, and illnesses.

Udwin et al. (2000) found that students who received psychological support after the crisis were able to solve their problems in a healthy way and adapt to daily life more easily. During the previous SARS outbreak, some countries have opened online platforms to provide psychological counseling services to family members and other people affected by the pandemic and have identified methods for psychological crisis interventions that make it easier to cope with the impacts of the pandemic on public health (Duan and Zhu, 2020; Tönbül, 2020). Similarly, the Turkish Ministry of National Education has established a hotline for students and parents for psychosocial support. With the call of the Directorate General of Special Education and Guidance, professional counselors helped students and parents

cope with the undesirable effects of COVID-19. In order to support students and their parents, 1,375 experts have been appointed to Guidance and Research Centers in all provinces of Turkey.

Changes in learning environments after the COVID-19 pandemic have created changes in the education process and practices. These changes affected all segments of the society as well as teachers. Teachers have tried to keep up with this new environment. At this point, school counselors also make extraordinary efforts to help students. However, since most of the job descriptions of counselors are formed around face-to-face contact, this new situation will be a process that needs to be explored for them as well. On the other hand, this will not be an obstacle for them, as school counselors make it their duty to help students and overcome obstacles (Kotarski, 2020).

In the SARS epidemic in 2003, it was reported that individuals' levels of knowledge, attitude, and panic played an important role in combating the disease (Person et al., 2004). In other words, experiences from previous outbreaks have revealed that individuals' knowledge, attitudes, and behaviors are important in controlling the spread of viruses (Johnson and Hariharan, 2017; Güngör et al., 2020). Even based on these researches, the support of counselors who have received professional training in the mentioned subjects in this process is important. In addition, counselors need to protect their mental health in order to help students. They should not neglect themselves. They should continue their activities that will be good for them (Kotarski, 2020).

The fact that the pandemic cannot be controlled in the COVID-19 outbreak and creates a wide sphere of influence and carries the risk of contamination to all people suggests that it will cause greater problems than other epidemics and pandemics. It is important to evaluate the educational/psychosocial effects as well as the health, economic, and political effects of the pandemic (Karataş, 2020).

When the literature is reviewed, it is seen that there are very few studies on adolescents during pandemic periods (Li et al., 2020). However, adolescence is a vital stage in development and emotional disorders, such as anxiety and depression can profoundly affect adolescents' health and school performance (Suldo et al., 2011). In this context, with COVID-19 pandemic in Turkey, a need has occurred for an evaluation of what role the counselors working at schools will play. Studies have highlighted many factors that contribute to the difficulties experienced by students. In addition, it is thought that there is much more to be learned about what can be done to reduce the negative psychological effects of the pandemic. More studies are needed to examine the impact of COVID-19 on students' mental health, and this should be done without delay. In this context, it is thought that this study will also shed light on this issue.

The purpose of the current study is to investigate the effects of COVID-19 on high school students' psychological symptoms and to understand how ready counselors and school counseling services are based on the data we have. Therefore, this research is designed under two different studies: (A) Study 1: Effects of COVID-19 pandemic on students' psychological symptoms and (B) Study 2: Views and expectations of students and school counselors about school counseling services.

STUDY 1: EFFECTS OF COVID-19 PANDEMIC ON STUDENTS' PSYCHOLOGICAL SYMPTOMS

During the COVID-19 pandemic, students' access to education activities through online platforms has increased the impact of the crisis situation experienced. Social/physical distance and other limitations can cause negative psychological situations, such as anxiety and fear, and these can affect students' well-being. High school students are among the groups with the most psychological difficulties during this period (Campbell, 2020; Çaykuş and Mutlu Çaykuş, 2020). Because they have had to take part in distance education activities without participating in any orientation process and adapt to this process without support. Therefore, for the purpose of Study 1, the answers to the following research questions were examined:

1. What is the total effect of event (COVID-19 pandemic) on high school students' symptoms of depression, anxiety, negative self-concept, somatization, and hostility?
2. Are there significant differences between male and female high school students' scores of psychological symptoms and impact of event?

Material and Methods

Power Analysis

To determine the number of cases needed for research question 1, at least five cases per parameter were calculated as a general rule of thumb (Brown, 2006). Considering that there were 75 parameters in the study, it was thought that a minimum of 375 participants would be sufficient for SEM analysis. An *a priori* power analysis using G*Power 3.0.10 (Faul et al., 2009) was used to calculate the minimum sample size needed to evaluate the research question 2. Using a high level of power of 0.95, a medium effect size as $f^2 = 0.15$, and a 0.05 alpha level (Cohen, 1992), the target sample size for this study was reported to be 146.

A total of 583 individuals participated in the study. Of them, 34 (5.83%) did not finish the entire questionnaire or failed to fill out two bogus items (check attention questions). The final sample included 549 individuals. There were more female ($n =$ 398, 72.5%) than male participants ($n = 151$, 27.5%); the average age of participants was 16.1, SD = 1.01. In terms of grade levels, 146 students were in 9th grade, 176 were in 10th grade, and 227 were in 11th grade.

Procedure

After getting the Ethics Board approval from the relevant university, we created an online form via Google Forms©. The study was conducted between May 15 and 25, 2020, when the quarantine restrictions were effective for individuals who were under 20 and above 65 years old. The online link was sent via emails to 10 high school principals who were randomly selected and represented seven regions of Turkey. There were 6,430 registered 9–12 grade students in these schools. Six school

principals responded our emails and accepted to distribute the link to their students. We did not include 12th grade students in the study since they would graduate and not be in schools in the next academic term. Hence, the link was delivered to 2,893 students who were in 9–11 grades. Taking this number into account, we have reached a 20% response rate in the current study.

Measures

Brief Symptom Inventory

We used the Brief Symptom Inventory (BSI) Turkish form (Sahin and Durak, 1994) for the current study. Derogatis (1992) developed the original BSI based on the Symptom Check List-90. This 53-item instrument consists of five subscales evaluating anxiety, depression, negative self-concept, somatization, and hostility in the Turkish version. The BSI uses a five-point Likert-type response format with values ranging from 0 = *Not at all* to 4 = *Extremely*. There is also an R = Refused option if participants do not want to respond to the items. The BSI starts with the question of "DURING THE PAST SEVEN DAYS, how much were you distressed by:" and includes items such as "Thoughts of death or dying" and "Feeling lonely."

Sahin and Durak (1994) reported moderate Cronbach's alpha coefficients for depression (α = 0.88), anxiety (α = 0.87), negative self-concept (α = 0.87), somatization (α = 0.75), and hostility (α = 0.76). For the current study, we calculated Cronbach's alpha coefficients for depression (α = 0.91), anxiety (α = 0.89), negative self-concept (α = 0.89), somatization (α = 0.82), and hostility (α = 0.82).

Impact of Event Scale-Revised

The Impact of Event Scale-Revised (IES-R) (Weiss and Marmar, 1997) was developed to assess impact of events and traumatic stress symptoms based on the Diagnostic and Statistical Manual of Mental Disorders IV-TR (American Psychiatric Association, 2000). In the current study, we used the IES-R Turkish form, which was validated by Çorapçioglu et al. (2006).

This 22-item instrument consists of three subscales assessing avoidance, intrusion, and hyperarousal. The IES-R uses a 5-point Likert-type response format with values ranging from 0 = *Not at all* to 4 = *Extremely*. The measure starts with the question of "DURING THE PAST SEVEN DAYS with respect to_____, how much were you distressed or bothered by these difficulties?" and includes responses such as "I was aware that I still had a lot of feelings about it, but I didn't deal with them" and "I avoided letting myself get upset when I thought about it or was reminded of it." An optimal cutoff score of 50 is used to diagnose posttraumatic stress disorder symptomology in community samples (Creamer et al., 2003). Wang et al. (2020) reported that a cutoff score of 37 or above could be used for "severe psychological impact" category. Çorapçioglu et al. (2006) reported a strong Cronbach's alpha coefficient of 0.94. For the current study, similar to the previous studies, we calculated a Cronbach's alpha of 0.92 as an indicator of strong consistency.

TABLE 1 | Means, standard deviations, reliability coefficients, and bivariate correlations for scores among variables.

Variable	1	2	3	4	5	6
1. Anxiety	–					
2. Depression	0.85*	–				
3. Negative self-concept	0.85*	0.85*	–			
4. Somatization	0.80*	0.73*	0.72*	–		
5. Hostility	0.76*	0.74*	0.75*	0.66*	–	
6. Impact of event	0.73*	0.67*	0.67*	0.64*	0.62*	–
M	17.76	20.53	15.90	9.02	11.28	31.11
SD	11.88	12.74	11.63	7.41	6.71	19.44
α	0.89	0.91	0.90	0.82	0.82	0.92

*$p < 0.01$.

Statistical Analysis

The SPSS 25.0 and AMOS 22.0 programs were used to run analyses. First, descriptive statistics, correlational analysis, and alpha coefficients were computed for each instrument used in the study (see **Table 1**). Next, an SEM was created to answer the research question one (see **Figure 1**). The assumptions of multivariate normality were tested. To assess the assumption of multivariate normality, the Mardia's statistic was computed. The results indicated that Mardia's coefficient was significant (8.66) and greater than the critical ratio (1.96; Mardia, 1970). However, this test is highly sensitive to larger sample size. Therefore, the kurtosis values for individual variables were inspected (Stevens, 2009), and all of the values were between −0.34 (anxiety) and −0.97 (depression), which means that the data were normally distributed (Westfall and Henning, 2013). We interpreted the chi square statistic (χ^2) and *p*-values, as well as goodness of fit index (GFI), comparative fit index (CFI), Tucker–Lewis index (TLI), standardized root mean square residual (SRMR), and the root mean square error of approximation (RMSEA) metrics of model fit. We used the values for the χ^2 ($p > 0.05$), GFI > 0.90, CFI > 0.90, TLI > 0.90, SRMR < 0.08, and RMSEA < 0.08 representing an acceptable model fit (Dimitrov, 2012).

To answer research question 2, a one-way multivariate ANOVA (MANOVA) was conducted. The independent variable was gender, and dependent variables were depression, anxiety, negative self-concept, somatization, hostility, and traumatic stress symptoms. We did not perform a *post-hoc* analysis since gender has two levels (male and female). Their mean scores on the scales were compared if the results indicated that there were significant differences.

Results

The descriptive statistics and correlations between variables are presented in **Table 1**. The IES-R scores showed that 201 (36.6%) individuals had scores of 37 and above, indicating high impact of event. Of this, 107 (19.50%) had a score of 50 and above, pointing out that individuals in this group had severe impact of event/trauma symptomologies. All the correlations among variables were significant. The impact of event (COVID-19 pandemic) had the highest relationship with anxiety ($r = 0.73$) and the

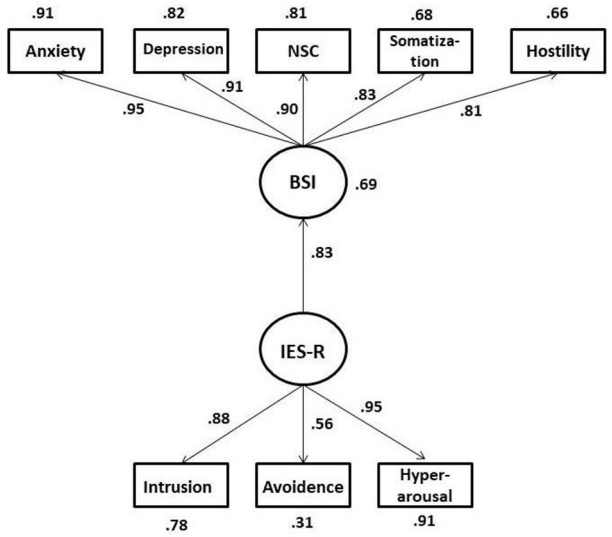

FIGURE 1 | Structural model depicting the effects of Impact of Events Scale-Revised (IES-R) scores on Brief Symptom Inventory (BSI) Scores.

TABLE 2 | Descriptive statistics for male and female participants.

Variable	Gender	*M*	*SD*	*N*
Impact of event	Female	32.46	18.85	398
	Male	27.53	20.55	151
Anxiety	Female	18.92	12.09	398
	Male	14.68	10.76	151
Depression	Female	22.41	12.71	398
	Male	15.57	11.46	151
Negative self-concept	Female	16.68	11.94	398
	Male	13.86	10.56	151
Somatization	Female	9.54	7.48	398
	Male	7.63	7.09	151
Hostility	Female	11.63	6.78	398
	Male	10.37	6.44	151

lowest relationship with hostility ($r = 0.62$). The hypothesized model was tested, and the fit indices indicated that the model had a strong fit: $\chi^2(19) = 71.98$, $p < 0.001$, $\chi^2/df = 3.78$; CFI = 0.98, TLI = 0.98, GFI = 0.96, RMSEA = 0.07 (90% CI = 0.054–0.089), and SRMR = 0.022. All the regression weights were significant, $p < 0.001$. There was a strong direct effect of impact of event (COVID-19 pandemic) on psychological symptoms (0.83). This means that as the individuals' IES-R scores increased, their psychological symptom scores also increased. In addition, the results indicated that IES-R scores explained 69% of total variance in psychological symptoms of individuals. Specifically, IES-R scores had a total effect of 0.79 on anxiety, 0.75 on depression, 0.74 on negative self-concept, 0.68 on somatization, and 0.66 on hostility scores. In other words, individuals' traumatic-/pandemic-related events had high effects on their psychological symptoms when the data were collected.

A one-way MANOVA was conducted to answer research question 2. The analysis examined the effect of gender (male and female) on levels of anxiety, depression, negative self-concept, somatization, hostility, and impact of events. An alpha level of 0.05 was utilized. Assumption for homogeneity of covariance (Box's $M = 6.98$, $p < 0.001$) was not met. Therefore, Pillai's trace was reported instead of Wilks' lambda, since it was more robust than the other statistics to violations of model assumptions (Olson, 1974). A statistically significant effect was identified between gender and the six dependent variables, Pillai's $V = 0.097$, $F_{(6, 542)} = 9.70$, $p < 0.001$. Approximately 10% of the variance in the model was accounted for in the combined dependent variables across gender, yielding a small effect.

Effects among subjects were inspected, and it was found that there was a statistically significant difference between groups in terms of anxiety, depression, negative self-concept, somatization, hostility, and impact of events variables. There were statistically significant differences between male and female subjects through all independent variables. Based upon these results, estimated marginal means were reviewed (see **Table 2**) and found that female high school students had higher scores on all variables than male high school students.

Discussion of Study 1

The main purpose of the Study 1 was to understand how COVID-19 pandemic affected Turkish high school students in the current study during COVID-19 quarantine restrictions. All school settings including K-12 and universities were closed, and individuals under 20 years old were banned to go outside their homes based on these quarantine measures. The findings of Study 1 indicated significant results of psychological symptoms of participants.

First, of the participants, ∼20% ($n = 107$) reported a score of 50 or above on the IES-R scale. This scale measures the stress of individuals experiencing any trauma when the scale is applied (Çorapçioglu et al., 2006). Based on the result, a significant portion of participants showed traumatic symptoms during the quarantine restrictions. This finding is consistent with the previous studies just conducted in 2020 in other countries and cultures, stating that COVID-19 is an unusual, unexpected and traumatic event affecting individuals and societies in a wide range (Brooks et al., 2020; Demertzis and Eyerman, 2020; Fardin, 2020; Lei and Klopack, 2020; U-M Department of Psychiatry, 2020; Wang et al., 2020). Brooks et al. (2020) reviewed 24 studies that reported the psychological effects of pandemics on people. Symptoms of posttraumatic stress disorder, blurred mind, and anger were the risk factors reported most in the studies. One of the reasons for the current traumatic symptoms may be the feelings of insecurity and loss of control that participants experience during the quarantine process, as well as fears of losing family members and the people they know (e.g., friends, neighbors). Another reason could be the loss of routine and feeling out of control (Campbell, 2020). The COVID-19 has been an ongoing process, and little was known about it when the data were collected. As in many countries, regulations and sanctions have been introduced in Turkey to change daily life and habits.

Wang et al. (2020) stated that being a student was associated with higher scores of IES-R. High school students could not attend their schools, had difficulty motivating their classes, could not go out, and when they left, they were fined. As a result, individuals went into a process during which they could not control themselves and moved away from their daily routine, which may have triggered trauma symptoms.

The results also showed that traumatic symptoms affected participants' psychological symptoms strongly. The IES-R scores had high total effects on anxiety, depression, negative self-concept, somatization, and hostility. Based on this finding and correlational analysis, as trauma symptoms related to COVID-19 pandemic increased, psychological symptoms increased as well. Feeling unsafe, fear of death, risk of getting the coronavirus, being away from the school and social relationships, prolonged home quarantine, uncertainty about the future, and financial difficulties experienced by families may have triggered individuals' psychological symptoms. For example, Wiederhold (2020) examined high school students' "likes" and "shares" on the social media platforms, such as Instagram, Snapchat, Reddit, and TikTok, and found that their social media shares were related to anxiety, depression, and feeling powerless. In a study conducted in China at the beginning of the pandemic (Liu et al., 2020), the researchers found that the pandemic increased the risks of permanent mental distress. In another study conducted by YoungMinds (2020), 83% of young participants reported that the COVID-19 pandemic worsened preexisting mental health conditions due to school closure, loss of routine, and limited social connections. Considering that 201 participants (36.6%) had a score of 37 or above (severe psychological impact) in the current study, COVID-19 pandemic process affected high school students depression, anxiety, negative self-concept, somatization, and hostility.

The last finding worth discussing is the differences between the male and female high school students' scores of psychological symptoms and impact of event. The results indicated that female students had higher scores on anxiety, depression, negative self-concept, somatization, hostility, and impact of event. In other words, female students experienced this process more severely than male students. The study of Wang et al. (2020) with participants with an average age of 21 in February, at the beginning of the corona, in the days when restrictions began in China, also found differences in psychological symptoms between men and women. This finding was consistent with previous studies. For example, Hou et al. (2020) found that female subjects had more severe stress and anxiety symptoms than male subjects. However, there was no difference on depression levels. A recent report released by Statistics Canada (Moyser, 2020) showed that female participants reported worse mental health than male participants since the COVID-19 restrictions began. Similar results were reported by the National Center for Health Statistics (Terlizzi and Villarroel, 2020) stating that female subjects' symptoms of anxiety disorder and depression were higher than that of male subjects. However, in another study conducted by Cao et al. (2020), gender did not have significant effect on anxiety. As can be seen from these findings, the effects of the COVID-19 pandemic on gender vary according to the participating groups. In the current study, girls have higher scores than boys, which may be due to the girls taking on other responsibilities (e.g., take responsibility for younger siblings, help with household work) as well as their lessons during the restrictions. Another reason could be the social support that female participants receive from their social relationships outside the home. As stated by Siddiqui et al. (2019), female participants receive higher social support from significant others and friends than male participants. In this context, female participants may have been more exposed to the psychological effects of pandemic because they were deprived of social support, which is one of the important sources of support.

In the next study, we explored the difficulties students experienced, their expectations when the schools started, and school counselors' readiness. Moreover, we tried to understand if the school counselors had a plan to help students cope with psychological symptoms.

STUDY 2: SCHOOL COUNSELORS' AND STUDENTS' VIEWS ON DIFFICULTIES DUE TO COVID-19

The aim of the second study was to determine the difficulties experienced by students due to COVID-19. For this purpose, online semistructured interviews were conducted with the students and the school counselors. In this section, information about the process and preliminary results obtained within the scope of the study were shared.

Method

In this part, the difficulties experienced by the students due to COVID-19, the needs arising due to these difficulties, and the readiness levels of the schools to meet the students' needs were described with the phenomenological pattern, one of the qualitative research designs. The phenomenological approach mainly focus on the meaning, structure, and essence of the lived experiences of a phenomenon for a person or group of people (Patton, 2015). In this study, "the situation of schools in meeting the needs arising due to the difficulties experienced by students during the COVID-19 pandemic" was considered as a phenomenon and analyzed in depth. Answers to the following questions were sought: What kind of difficulties do students have in the pandemic process? What are their needs to deal with these challenges? After the pandemic, how ready are schools to respond to students' needs?

Participants

In accordance with the purpose of the study, participants were selected among the students and school counselors at high school level in Turkey using the maximum variation sampling method. In order to obtain more detailed information about the phenomenon examined, maximum diversity was achieved by taking into account studying or working in different cities and different types of high schools. In the interviews with the students and the school counselors, the differences were primarily determined, and then, a list of similar or common

aspects among the differences was created. Five school counselors from different cities and five students registered at the schools of these counselors participated in the study. Three of the students were male and two were female. Two students (one female and one male) were in the 9th grade, two students (one female and one male) were in the 10th grade, and finally, one male student was in the 11th grade. Considering the demographic characteristics of the counselors, four were women and one was a man. The age of counselors varied between 39 and 44. Counselors have been in the profession for a long time, and they were experienced (varied between 17 and 21 years).

Measures

The data were collected using the semistructured interviews used in qualitative research designs. "Student and School Counselor Semi-Structured Interview Forms" were prepared to collect data. In the preparation of the interview question forms, first, researchers and field experts were interviewed, and a draft form was created. After the draft was examined by a researcher who is a faculty member in the field of counseling and who is an expert in qualitative research, a pilot study was carried out. In the pilot study, a school counselor and a high school student were interviewed, and the form was finalized by ensuring consistency for the interviews. The sample questions in this interview form are as follows: "What kind of difficulties did you have at the beginning of COVID-19?" (student question) and "When you return to the school environment for education; what kind of difficulties may your students experience?" (school counselor question).

Procedure

Before conducting the interviews, informed consent form was obtained from the students, their parents, and the school counselors. In addition, before the interviews, questions were sent to the participants for review. Appointments and interviews were made according to the appropriate days and times for the participants. All of the interviews were conducted online due to the risk of COVID-19 contamination. Interviews ranged from 25 to 57 min. The statements of the individuals interviewed during the interviews were repeated, and participant confirmation was obtained again.

Analysis

The data obtained from the interviews were analyzed in four stages in accordance with the purpose of the research and the phenomenological pattern determined. These stages consist of (1) coding of data, (2) finding themes, (3) organizing codes and themes, and (4) defining and interpreting the findings (Creswell et al., 2007). The data obtained from the interviews were coded under three topics: "difficulties" that students experienced at the beginning of COVID-19 and when they return to school, "assistance needs" that arise due to these difficulties and "readiness levels" of school counseling services, and relevant categories were created. Then, themes and subthemes were created. In this context, the audio recordings obtained from the interviews were first deciphered by a researcher who was competent and experienced in the interview technique in the research team and transformed into a written text in a Word document. Before proceeding with the content analysis of the written texts, the content analysis was started by ensuring the coder reliability between the two researchers determined for content analysis. Themes, subthemes, and codes were created as a result of the analysis. The obtained codes were examined by the research team, the themes and codes were given their final form, and the findings of the research were defined and interpreted.

Trustworthiness

In this study, which was carried out with the semistructured interview technique, in order to ensure trustworthiness, the participants were informed about the purpose of the study and the interview process, and consent was obtained from the participants to express themselves sincerely with voluntary participation. There are four criteria for trustworthiness (Mabuza et al., 2014): (1) credibility, (2) transferability, (3) dependability, and (4) conformability. To achieve credibility, the interview recordings transmitted to the text were sent to the participants. By taking the feedback on the text, errors were extracted; thus, the accuracy and precision of the information were checked. Second, to achieve transferability, we used maximum variation sampling method.

In order to ensure reliability in the interviews, it was carried out by a single researcher who was competent and experienced in qualitative research and interview technique. The meanings of the questions for the interviewer and the participants were tested by conducting a pilot study with an interviewer student and a school counselor with the interview protocol prepared before the interviews. In addition, in order to ensure consistency in transcribing the audio recordings obtained as a result of the interview, a part of the recorded interview was analyzed in two different times, and the consistency in both decoding processes was tested. To achieve dependability and confirmability, constant comparison was made to ensure reliability in the coding process of the categories. With this method, interview data were encoded in categories by two different researchers were compared with each other (Mabuza et al., 2014).

Results

Findings on Students

We reported the difficulties experienced by students during the first semester break of face-to-face education at the beginning of COVID-19 in Turkey and the needs that arise due to these difficulties below. In addition, the difficulties they may face if they can start their face-to-face education again, the findings regarding the new needs that may arise based on these difficulties, and the readiness of schools to meet these needs of students are given below, respectively.

Difficulties Faced by Students During the Break in Face-to-Face Education at the Beginning of COVID-19

According to the findings of the interviews with high school students, the difficulties experienced by the students are divided into themes of educational, cognitive, emotional, physiological, relational, and technological difficulties and those related to routines.

Educational Difficulties. The most emphasized theme among the difficulties experienced by the students was related to their educational characteristics. The codes in this theme included preparation and participation in online lessons, time management in distance education, efficient studying, following courses, loss of academic achievement, online connection quality, staying away from educational materials, and weakening of school connection. It was observed that some of the students lost their connection and communication with the school during this process. A participant summarizes the situation, "*The school did not communicate with us much during this period. I couldn't feel the school with me*" (male, ninth grade student).

Cognitive Difficulties. While expressing the cognitive difficulties, findings were obtained regarding the participants' understanding of COVID-19 and realizing its seriousness. One participant expressed the process of making sense of COVID-19 and realizing its seriousness as "*At first, we thought it would last for a short while. Later, when the holiday got longer, we started to understand how serious the situation was*" (female, 10th grade student).

Emotional Difficulties. Among these difficulties, contagion anxiety, fear of death, fear of losing loved ones, fear of uncertainty, helplessness and sadness, quarantine pressure, and restriction of freedom were feelings experienced by some students. One participant expressed his opinion on the quarantine pressure as follows: "*I sometimes got angry because I stayed at home all the time*" (male, 10th grade student).

Physiological Difficulties. Among the physiological difficulties expressed by the students, there were sleep problems, appetite or overeating, sports activities, and face-to-face games. When the statements of the students were examined, the statement of a participant about difficulty in sleeping, which is chosen as an example of the situations they experience, was as follows: "*I couldn't open my eyes in the lessons. I've been sleeping and waking up even during the 10-minute break between classes*" (male, ninth grade student).

Relational Difficulties. Participants expressed their difficulties in relation to loss of relationship (friend, relative), loss of close contact, conflict with parents, sibling conflict, and visiting relatives. One of the participants expressed the relationship loss as follows: "*The most upsetting thing was the inability to communicate with my relatives. I really miss them*" (female, 10th grade student).

Technological Difficulties. Among the technological difficulties experienced by high school students were the problem of access and connection loss of online activities. A participant who expressed the problem of access: "*I work from sources myself, I try to find and watch new videos. This is getting a little more difficult. We could not get efficient lessons because the teachers had internet connection problems*" (female, ninth grade student).

Routines. It seems that some of the difficulties experienced by some students at the beginning of COVID-19 include changes in their routines. In situations that create anxiety and stress, routines may change during periods of uncertainty. Sleep time and meal time are among the routine changes experienced by the participants. One participant's views on the changes in sleep time were as follows: "*In the past, our lives were regular, we had a planned life. We were getting up at 8 in the morning and going to our school. Now our routine is broken*" (male, 10th grade student).

Difficulties That Can Be Faced if Students Start Face-to-Face Education

Academic, social, emotional, and behavioral themes come to the fore among the difficulties that can be experienced if students start face-to-face education.

Academic Difficulties. Participants expressed the issues of learning loss, loss of motivation, adaptation to the school environment, transition to face-to-face education, public places, education with masks, healthy transportation to school, and planning learning activities among the academic difficulties they may experience if they start face-to-face education. One participant expressed the learning loss with the following statements: "*We may not have learned as much from online education as we did from face-to-face training. Some of us may be behind the class*" (female, 10th grade student).

Social Emotional Difficulties. If they start face-to-face education, the students expressed the social and emotional difficulties they may experience as the fear of contagion, fear of loss of friends, insecurity about hygiene, worry that peers will be harmed, establishing intimacy, and maintaining relationships at physical distance. Expressing his fear of contamination, a student said, "*I am afraid that some of our friends will not keep their distance. If they get close to us then it will be dangerous*" (male, ninth grade student).

Behavioral Difficulties. Students stated that if they start face-to-face education, they will experience behavioral difficulties in physical contact, not touching things at school, and obeying the rules. One participant, on the other hand, stated the difficulty of obeying the rules, "*I think that students will not be able to take adequate precautions against the risk of virus in classrooms, and not everyone will follow the rules*" (female, ninth grade student).

Psychological Needs That May Occur for Students After COVID-19

If the students can start face-to-face education, they have certain expectations from the counseling service so that they can cope with the difficulties they may experience during the distance education process and in the process of readaptation to school. These expectations were divided into motivation, adaptation to school, peer support, determination of needs, social assistance, coping with the pandemic, individual support, planned work, and problem solving. A participant who wanted the counseling service to do an orientation program said the following: "*I want them to think about how they will enable us to adapt to the new situation and make preparations*" (male, 11th grade student).

Findings Regarding the Views of School Counselors

This section includes findings from interviews with school counselors who work at high schools in Turkey. The findings related to the difficulties experienced by students at the time of interruption of education at the beginning of COVID-19, services provided to the students in this process, the difficulties students can experience if they start face-to-face education again, and the planned services to be offered in Turkey will be cited.

Difficulties Experienced by Students at the Beginning of COVID-19

According to the analysis results obtained from the interviews with the school counselors, the difficulties experienced by the students at the beginning of COVID-19 were grouped under family relations, personal–social, emotional, and academic themes.

Family Relations. According to the views of school counselors, family pressure, family conflict, high expectations of family, conflict with parents, and protection of borders in family relationships were among the difficulties students experienced in family relationships. Stating that the expectations of families at the onset of COVID-19 were perceived as a problem by students, one participant expressed her opinion as follows: "*Families want their children to study as they did when the school was open*" (female, 17-year experience).

Emotional Difficulties. School counselors expressed uncertainty, fear of transmission, anxiety and restlessness, loneliness, boredom–depressed, death of the loved ones and mourning, and fear of losing loved ones among the emotional difficulties experienced by students at the onset of COVID-19. A participant stated for the students experiencing sense of grief, "*The father of one of our students, grandfather and sister living in the same apartment were tested positive for COVID-19. I had one-on-one meetings and studied with him. In fact, that student lost his grandfather*" (female, 19-year experience).

Personal Social Difficulties. Among the results obtained from interviews with school counselors regarding personal social difficulties were relationship building, autonomy, fun, responsibilities, communication conflict, and daily life skills. One participant told about the students who could not meet the need for relationship: "*Talk about our problems. We observed that no matter how many people in the house are together, we need communication with peers. My students said they wish the school opened as soon as possible. When I asked why, they were either very bored, very overwhelmed, they would never want to see their friend's face, but they even missed him*" (female, 21-year experience).

Academic Difficulties. School counselors stated that among the academic difficulties experienced by their students at the onset of COVID-19 were amotivation, uncertainty regarding education, loss of learning, loss of success, effective work, academic responsibilities, adaptation to distance education, and time management. For the difficulties regarding distance education, another participant said, "*They had difficulty concentrating on the lessons during the distance education process*" (male, 20-year experience).

School Counseling Services at the Onset of COVID-19

When COVID-19 started, the services offered by school counselors were discussed under three main themes: (1) services for the student, (2) services for the family, and (3) services for the teacher.

Services for Students. Services offered by school counselors for the student at the onset of COVID-19 included individual counseling (online), individual counseling (online), form filling (online), interview (online, face-to-face, phone), group counseling (online), peer counseling, vocational guidance, preventive counseling, and social assistance. One participant expressed her opinion about online individual counseling service as follows: "*I had 10–12 students with whom I did personal counseling every week. When this process started, we tried to make an online counseling*" (female, 17-year experience).

Services for Families. At the onset of COVID-19, it was observed that school counselors continued the services they had previously planned for their families, in addition to family counseling, parent meetings, parent needs analysis, online parent seminar, and home visits. One participant stated that he went for a home visit to a student who lost his father as follows: "*The father of one of our students had a heart attack during this period, he passed away. I called my student… We even came together with fellow teachers and went to the house of this student who lives in a different city for a condolence visit and support*" (male, 20-year experience).

Services for Teachers. It was observed that school counselors' services for teachers were limited at the onset of COVID-19. These services included consultation. The statement of a participant for the consultation service is as follows: "*We held meetings every Friday. We held a meeting as a counseling service with all teachers and administrators, which lasted about one and a half hours. We made a general weekly evaluation*" (female, 21-year experience).

Difficulties that Students May Encounter in Transition to Face-to-Face Education

According to the opinions of the school counselors, the expressions of the students regarding the difficulties they may experience if they start face-to-face education are divided into themes in emotional, academic, and relational ways.

Emotional Difficulties. According to the views of the counselors, the emotions that students may experience when they start face-to-face education included fear of contagion, loss and grief, fear of losing loved ones, rule pressure, and career anxiety. One of the participants expressed her ideas about the students experiencing grief: "*In this process, there will definitely be some of our students or teachers who lose their relatives. They may have needs regarding the support and grief process*" (female, 19-year experience).

Academic Difficulties. According to the opinions of the school counselors, if students start face-to-face education, the academic difficulties they may experience include education under the fear of contagion, learning losses experienced in the distance education process, weakening of the school connection, loss of motivation, adaptation to school life, working habits, and time management. A participant emphasized the difficulty of education under the fear of contamination, "*We're putting 35 students into a class for 25 students…I think the physical conditions will create a much bigger problem*" (female, 21-year experience).

Relationship Difficulties. According to the views of the school counselors, the relational difficulties that students may experience when they start face-to-face education were keeping distance in relationships, maintaining close relationships at a distance, and family pressure. Referring to the issue of maintaining distance in their relationships, a school counselor expressed his views as follows: "*We will have students who do not want measures such as distance, masks, and who do not want to be separated from their close friends in physical distance*" (male, 20-year experience).

Planned Counseling Services for the Possible Needs of Students if They Can Start Face-to-Face Education

Information on the preparations planned within the school counseling services for the needs of students that may arise in case of face-to-face education during the pandemic period was determined based on the opinions of the school counselors. When the services planned by school counselors after COVID-19 were examined, it was seen that their preparations were on the following issues: orientation, psychosocial support, empowerment of families, empowerment of teachers, needs analysis, and individual and group meetings. One of the participants expressed psychosocial support studies as, "*In this period, I think we will give a lot of space and time especially to the psychosocial support program. We will try to implement the activities in that program. Especially in the psychosocial support program published this year, there were modules in areas such as migration, trauma, and suicide. Perhaps a new module on the pandemic can be prepared and implemented*" (female, 17-year experience).

Discussion of Study 2

Students' Needs (at the Beginning of COVID-19)

According to the results of the study, the students expressed the difficulties they experienced at the onset of COVID-19 as educational, cognitive, emotional, physiological, relational, and technological difficulties and those related to routines. School counselors, on the other hand, described the difficulties that their students experienced at the onset of COVID-19 as family relations, personal–social, emotional, and academic ones.

It was observed that school counselors provide services for students, families, and teachers in order to meet these needs at the onset of COVID-19. The challenges high school students experienced during COVID-19 in Turkey had similarities with the results of research conducted in different countries (Gualano et al., 2020; Zhang et al., 2020). According to WHO (2020c), sudden closure of schools had negative effects on students' health, education, and development. Some studies conducted on the general population and youth during the COVID-19 period generally focus on psychological problems and psychological symptoms (Liang et al., 2020; Xiong et al., 2020). Although not being able to go to school, staying at home and curfews are deemed appropriate in terms of public health, they can have a threatening effect on the mental health of the society. There are studies showing that the stress and anxiety levels of students increase during this period when they stay at home (Huskya et al., 2020).

Rajkumar (2020) found that the COVID-19 outbreak was associated with depression, stress, sleep disorders, and other psychological symptoms. Factors that cause students' stress, anxiety, and depressive thoughts included fears and worries about themselves and their loved ones' health, focusing problems, disruption of sleep patterns, and an increase in social anxiety due to physical distance (Son et al., 2020). In the same study, academic difficulties experienced with the sudden transition to online education processes were discussed.

The challenges caused by COVID-19 and the needs of students will also change their expectations from school counseling services. The readiness of both students and school counseling offices for this change is very valuable for the protection of the mental health of the community. In the face of such a difficulty, it may not be possible for students to manage all their difficulties on their own and cope with their difficulties in the process. Although studies have given some ideas about dealing with the stress situations experienced during the COVID-19 period, it is important to produce effective and permanent services in this regard. According to a study conducted on adolescents in China, it has been observed that positively coping with the psychological symptoms associated with COVID-19 is a protective factor (Zhang et al., 2020). At the same time, seeking help from others is among the methods used along with positive coping (Son et al., 2020).

Students' Needs (After COVID-19)

It has been determined that students may experience difficulties in academic, social–emotional, and behavioral areas if they start face-to-face education. School counselors, on the other hand, divided the expressions about the difficulties that students may experience if they start face-to-face education into themes, emotional, academic, and relational ones. Although the difficulties of students and school counselors with respect to the onset of COVID-19 or the period when schools reopen are expressed relatively differently, the difficulty experienced or felt by each student in either period will not be as low as in the pre-COVID-19 period. It becomes important to restructure school counseling services and to shape service models and processes for each student to cope with more intense difficulties. Considering the results of this research regarding the expectations of the students from the counseling services when they return to face-to-face education and the services that the school psychological counselors plan to provide, it is remarkable that there are no new searches and many uncertainties.

As with the onset of COVID-19, it is estimated that students will seek help from the counseling service at a limited level in the future. Among the reasons for this, it is thought that it will be difficult to provide services individually, especially due to the time limitation and inadequate number of the school counselors, and that participation in group activities to be held face-to-face or online will be limited. One of the reasons for the low participation in online trainings, in particular, is the lack of trust in telephone or online services (Son et al., 2020). For this reason, school counselors may need to advertise telephone or online services and establish the trust of students, parents, and teachers in these services. It is known that there is stigma as an obstacle for students to benefit from school counseling services (Martin, 2010). Measures should be taken to prevent stigma in online services to be provided by the school counseling office.

In school counseling services, it can be especially effective to provide students with self-management and coping skills (Son et al., 2020). However, even if the school is open from now on, it may be necessary to continue all or some of the counseling services for schools remotely (online–phone, etc.) because of time efficiency and risk of contamination. For this reason, it may be necessary to increase the quality of the services to be provided online or by phone and the trust in it. In crisis situations such as COVID-19, it is necessary to consider situations that threaten mental health, to provide preventive mental health services to all students, to provide list of rehabilitation centers to students in need, as well as to identify students who have high levels of psychological difficulties and to refer the students who cannot be supported by the school counselor to appropriate mental health services.

IMPLICATIONS

COVID-19 pandemic has been shown to affect psychological symptoms, such as depression, anxiety, negative self-concept, and somatization among high school students. This finding has also been emphasized in UNICEF's (2020) report. School counselors need to be prepared to deal with these situations. In this sense, school counselors can work on online intervention programs to cope with students' psychological symptoms, such as anxiety and depression. The more mindfulness self-regulation/emotion regulation techniques are included in these intervention programs, the better the results can be. At this point, dialectical behavior therapy (DDT) prepared for adolescents can be utilized (Rathus and ve Miller, 2015; Ricard et al., 2018; Karaman, 2019). DDT can be applied in four different modules (Individual therapy, Skill training, Phone calls, Consultation team meetings). The most commonly used module with adolescents is the skill training module and consists of five skills: (1) Emotion dysregulation, (2) Interpersonal dysregulation, (3) Behavioral dysregulation, (4) Cognitive dysregulation and family conflict, and (5) Self-dysregulation (Rathus and ve Miller, 2015; Karaman, 2019). School counselors should also focus on protective factors that will eliminate psychological symptoms. School counselors, who are in contact with adolescents from various demographic backgrounds, have an important role to select interventions that will empower students and initiate and maintain interventions (Sheridan and Gutkin, 2000; Moolla and Lazarus, 2014).

Adolescents develop psychologically, cognitively, and socially in addition to biological development. In other words, adolescence is a period of intense biosocial changes. From this perspective, it is difficult for adolescents to stay away from their friends in this developmental stage. However, with online social skills training by school counselors, if skills about managing and implementing their own ideas in their social networks are provided, they can overcome this situation with the least damage because adolescents have a significant capacity to influence each other (Andrews et al., 2020). School counselors and parents should be aware of this.

Undoubtedly, one of the profession groups that have difficulties in this process is school counselors. The counselors, who carried out all activities face-to-face until the pandemic, had to carry all their services online during the pandemic outbreak. However, they did not receive such an education at universities. In addition, they had to deal with such a large student crowd alone with increased psychological symptoms. In this process, either the number of school counselors should be increased or other school staff should be included in providing consultancy services during the outbreak. For example, school counselors can focus on psychological symptoms by assigning other teachers to monitor students who have difficulties in academic development. Otherwise, school counselors will come to the point of exhaustion (Luthar and Mendes, 2020).

In summary, considering the difficulties experienced by students and teachers in this process, all plans should be adjusted according to online consultancy in situations that may occur in the future such as pandemics or require online consultation. It is important for universities to plan accordingly and for public institutions to support this structuring.

LIMITATIONS AND SUGGESTIONS FOR FUTURE STUDIES

The study was conducted on an exceptional time. When we collected data, the quarantine restrictions were strictly enforced. There was uncertainty about where the pandemic was heading, and it was not clear how long it would last. Vaccine studies had progressed significantly but did not come close to the end. Therefore, the results should be evaluated taking these into account. In other words, if the study is repeated with a similar group now, different or reverse results may be obtained because the conditions are not the same. In addition, the cross-sectional nature of the Study 1 prevents concerns about causality. Last, although the current study has statistically significant and meaningful results, it should be evaluated taking into account the low response rate, the cross-sectional characteristics of the study, the data collection period, and the group of participants. Hence, Study 1 should be taken as a preliminary research.

One limitation that may be related to Study 2 is that the interviews were made remotely and by phone and not face to face. Therefore, non-verbal bodily reactions of the interviewees

were ignored in our study. Last, the current study is a preliminary study, and due to the nature of qualitative studies, we cannot generalize our findings to the general population. The study should be repeated in order to reach more information about this issue or to reach general judgments.

Counselors working with adolescents should be investigated for their capacity to help students after this trauma and what kind of psychoeducation/training programs they need in this regard. In addition, research is needed to increase the level of well-being of students and teachers. In addition to this research, which examines the individual psychological effects of the pandemic period and its aftermath on students, the research can be expanded by adding all environmental factors (microsystem, mesosystem, exosystem, and macrosystem), or this study can be repeated over different age groups (university students, counseling centers).

CONCLUSION

Contemporary and developed societies aim for students to lead a better quality of life by providing their cognitive, social, emotional, moral, and behavioral development with the contents in their education systems. From this point of view, it has been obvious that schools have a determining effect on the quality of life of students. It is inevitable for schools, which have such a determining effect on the development of individuals, to undertake a function that facilitates coping with the difficulties that students experience and may experience in the process and the problems that may arise due to these difficulties. Student personality services to be prepared and implemented by school counseling services are vital for schools to fulfill this function. It has become inevitable for schools to make plans regarding situations such as (a) the possibility that COVID-19 pandemic may continue for a long time and (b) COVID-19 pandemic can be brought under control in a short time and education can be started again in its old normal order. In order for school counseling services to provide the psychological support and other assistance services needed in both cases, sufficient numbers of well-equipped and competent school counselors are needed.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Kilis 7 Aralik University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

MAK conceived the study and ran the analyses for Study 1 and wrote methods, results, and discussion for Study 1. HE ran the analyses, and wrote methods, results, and discussion for Study 2. İHT wrote the implications, limitations, and conclusion. RA wrote the introduction. All authors contributed to the article and approved the submitted version.

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How E-Learning Environmental Stimuli Influence Determinates of Learning Engagement in the Context of COVID-19? SOR Model Perspective

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The COVID-19 pandemic at the beginning of 2020 has changed the conventional learning mode for most students at schools all over the world, and the e-learning at home has become a new trend. Taking Chinese college students as the research subject and drawing on the stimulus–organism–response (S-O-R) model, this paper examines the relationship between the peer referent, perceived closeness, and perceived control and the learning engagement. Using data from 377 college students who have used e-learning, this study shows that perceived closeness, perceived control, and peer referents in e-learning have a positive effect on the self-efficacy and well-being of students, thus improving students' enthusiasm for learning. Our intent is to assist researchers, instructors, designers, and others in identifying effective methods to conceptualize and measure student engagement in e-learning.

Keywords: COVID-19, e-learning, environmental stimuli, learning engagement, S-O-R model

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INTRODUCTION

Learning environmental stimuli have always been the key factor affecting the level learning intention among students (Chang et al., 2008). Many studies have shown that good learning environmental stimuli enhance students' intrinsic learning motivation and help them to obtain the required knowledge and skills, thus achieving the scheduled goals (Bojuwoye et al., 2014). Mashau (2000) holds that schools have the responsibility for creating a favorable learning environment to promote effective learning, and students would benefit from mutual assistance among peers, improved courses, and high-quality teaching strategies in such an environment (Hewson and Hewson, 1983). Nowadays, college education is facing multiple challenges, and encouraging student engagement in learning has become the focus of increasing attention (Ngidi and Qwabe, 2006). However, most previous studies have explored the learning effect of e-learning taken by students in a stable environment. For instance, Al-Rahmi et al. (2019) adopted the technology acceptance model to explore behavioral intention of students in using the e-learning system. Abuhassna et al. (2020) established a research model with transactional distance theory and Bloom's taxonomy theory and discussed the effect of relevant factors on learning satisfaction and academic achievements when they are involved in online learning platforms. Despite these studies showing that students who adopt SNSs for learning have significantly positive output, the situational context of the study design tends to be stable and provides students with e-learning environment in a

guided manner (Jayachithra, 2020). For students who have to adopt e-learning due to the situational context extended by sudden environmental changes, the gap in their psychological cognition may lead to differences in learning effect and learning process (Shahzad et al., 2020). Thus, to understand this gap, this study further explores the psychological cognitive process in which students are involved in e-learning in the context of pandemic outbreak.

Allen and Seaman (2011) point out that about one third of students pursuing higher education in America have attended one or more e-learning subjects at home. Bach et al. (2006) regard e-learning as a critical component for the popularization of higher education. In particular, since the onset of the coronavirus disease 2019 (COVID-19) global pandemic in January 2020, countries all over the world have suspended (to a certain extent) economic, tourism, and catering activities, especially educational activities. In China, which suffered early from the epidemic, schools carried out remote teaching through e-learning to allow students to learn at home, and e-learning changes traditional educational activities to a digital form in terms of content and systems (Putra et al., 2019). However, students' engagement in e-learning is obviously lower than in face-to-face teaching (Dietz-Uhler et al., 2007). Jonassen et al. (2003) propose that one possible reason may be that the student attention in e-learning is easily distracted by other factors. The change of the learning environment may also lead students to drop out of school or reduce their enthusiasm for pursuing their degree courses (Jaggars, 2014). Nevertheless, there are still many scholars who believe that e-learning brings positive effects to student learning (Al-Rahmi et al., 2019; Abuhassna et al., 2020; Jayachithra, 2020), particularly Shahzad et al. (2020) who explored the effect of COVID-19 in e-learning on students. Despite their studies showing that gender differences have different results for the use satisfaction, the relationship between the variables is significantly positive. The possible reasons come from the students' learning autonomy and the establishment of learning targets. Besides, the changes in the learning environment brought by the COVID-19 global pandemic have changed students' learning patterns, but scholars believe that learning targets still exist in their learning process. According to the social cognitive theory from Bandura (1986), as for the behavioral motivation derived from the establishment of learning targets, it does not come from the establishment of learning targets itself, but is influenced by the self-regulated process. Zimmerman (2008) also stated that self-regulated learning is a process of transformation, in which students will adjust their learning patterns and learning targets according to different situations and conditions. In other words, based on the self-regulated view, students are changed from traditional classroom learning to online learning, and at the moment, they will adjust the learning devotion mode and targets through the ways of orientation, regulation, persistence, and evaluation (David et al., 2007). Based on the above arguments, this study aims to explore the development process of learning engagement for students in the context of online learning.

Although students can acquire valuable knowledge and information from teachers *via* e-learning, it is not certain that such knowledge and information can be converted into high-quality competence. In studies of organizational management, Zaheer and Bell (2005) found that more attention should be paid to the internal capability of an organization in knowledge absorption (i.e., the learning engagement), while the acquisition of external knowledge and information tends to be more often discussed (Cohen and Levinthal, 1990). In terms of the connectedness stressed by Fabrizio (2009), students should be able to engage in learning actively, and transmit and use knowledge. Although teachers have provided abundant and valuable information in the context of e-learning, learning quality is particularly difficult to control (Putra et al., 2019) and a higher learning engagement from students is required. Most previous studies have discussed the importance of e-learning (Wang and Wang, 2011), but there have been few studies on the impact of the learning environmental stimuli perceived by students in e-learning on student engagement. When discussing the process of student learning engagement derived from the stimulation of learning environment, previous psychologists put forward the S-R theory (Hommel, 1997; Gast and Rothermund, 2011; Hazeltine and Schumacher, 2016). The S-R theory argues that an individual will directly make the right response after receiving external stimulus. In the past, most in the SO theory discussed how to transform into a specific response under given stimulating conditions, or the subsequent behavior of an individual after participating in a certain stimuli event (Hommel, 1997; Hazeltine and Schumacher, 2016). Since humans are organisms that generate psychological elements of feelings, moods, emotions, or attitudes in response to stimuli, thus the stimulus–organism–response (S-O-R) model is extended (Khan et al., 2017; Kim and Park, 2019; Zhai et al., 2020). To explore the psychological feelings and learning responses of students stimulated by the changes in learning environment under the circumstances of COVID-19, here, we introduce the S-O-R model and connect learning engagement in e-learning with the e-learning environment. Although previous studies have used this framework to examine the effect of the e-learning human–computer interface (HMI) on student behavior (Zhang et al., 2014, 2015), this study emphasizes the environmental factors of e-learning, rather than the technical factors, demonstrating the applicability of using the S-O-R model when considering learning engagement in the context of e-learning. In particular, this study focuses on the current situation of learning engagement among college students in the context of e-learning due to the COVID-19 pandemic.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Theoretical Background

The S-O-R model involves three components: stimulus, impact, and response. It assumes that stimuli (S) are included in the external environment and cause changes to people's internal organisms (O), which in turn affect their behavioral responses (R; Mehrabian and Russell, 1974). This model is used to conceptualize the individuals' responses to environmental information. It can capture behavioral responses and elements in complex decision-making processes (Bagozzi, 1983). In this theoretical framework, stimuli appear in different forms,

including environmental factors and interpersonal relationship (Animesh et al., 2011; Liu et al., 2016). Such changes to internal status appear in the perception of stimuli and behaviors, including affective, cognitive, perceptual, and mental activities. Zhai et al. (2020) argued in the study that when discussing students' engagement in e-learning or SNSs, the S-O-R model is a good fit for the context used in researching the online user behaviors. With the spread of the global COVID-19 pandemic, many patterns of learning have begun to transform from offline classroom to online classroom, and the sudden changes in learning environment have compelled students to try to adopt multimedia tools for learning (Khan et al., 2017; Zhan et al., 2020). The psychological changes may induce students to have different learning styles and engagement behaviors; thus, it is necessary to utilize the S-O-R model to further explore the development of their entire learning process.

Previous studies of the S-O-R model have considered a wide range of stimuli, including social support (Zhang et al., 2014), flow (Animesh et al., 2011; Gao and Bai, 2014; Zhang et al., 2014), feeling (Koo and Ju, 2010; Vieira, 2013; Kim and Johnson, 2016), and interaction (Mollen and Wilson, 2010; Animesh et al., 2011; Zhao and Lu, 2012). The individual response after the reception of stimuli refers to the effective attitude and intention in subsequent individual behaviors, such as learning autonomy and learning intention (Animesh et al., 2011; Ha and Im, 2012). When it comes to the application of models, scholars set up different S-O-R models according to the situational conditions, making the application of the S-O-R model more perfect. For instance, Zhan et al. (2020) adopted the S-O-R model to explore how privacy concern develops knowledge hiding perceptions of the learners, thereby affecting their online collaboration. Good reliability, validity, and model fits are shown in their study, such as χ^2 (CMIN/df) = 2.56, $p < 0.001$, standardized root mean square residual (SRMR) = 0.06, IFI = 0.91, CFI = 0.92, TLI = 0.91, and RMSEA = 0.074. Khan et al. (2017) established the S-O-R model to study the students' flow experience in education and other personality traits, and showed that the research model also has good model fits, such as χ^2/df = 2.16, CFI = 0.969, TLI = 0.940, and RMSEA = 0.060. Thus, it can be proved that constructing student learning status with the S-O-R model can gain a good explanation.

According to the S-O-R model, all behavioral outcomes involve a process of integrating of internal and external parts: the external interactive process of people with the environment and the internal psychological process of acquisition and obtainment (Illeris, 2003). The external interactive process is the social dimension, such as perception and contact. It affects the integration of environment and individuals and changes people's behaviors. We believe that the stimuli perceived in the e-learning environment can be considered stimuli of the external environment and are correlated with the mental response generated in learning (subjective well-being) and self-efficacy. We therefore consider here how peer referent, perceived closeness, and perceived control are related to students' mental response. An internal psychological process is a process where the cognitive function and subjective feeling interact with each other (Illeris, 2003), and here, we divide the internal psychological process into two parts: self-efficacy and subjective well-being.

Learning Engagement

Learning engagement is the student behavior of participating in learning activities for better acquiring knowledge or skills (Hu and Hui, 2012), and it is susceptible to the qualities of the learning environment. Learning engagement emphasizes the importance of behavior (e.g., engagement), affection (e.g., well-being or satisfaction), and cognitive engagement in learning (Lam et al., 2012). It is one of the foremost factors for improving learning outcomes, as shown by many previous studies (Klem and Connell, 2004; McMahon and Portelli, 2004; Carini et al., 2006).

When students engage in learning on their own initiative, they take initiative in and/or concentrate on acquiring and applying new skills or knowledge, solve problems using underlying approaches, and show a positive attitude toward their learning process (Deater-Deckard et al., 2013). The development of models and measures that promote student learning engagement is crucial to the development of the field of education (Zahn, 1980). The more students engage in learning, the higher their enthusiasm for learning will be and the better progress they will make.

Self-Efficacy

Scholars argue that an individual's behavioral outcome is affected by environmental factors, in particular situation (Dinther et al., 2011), especially for those beliefs leading to success. This belief is called "self-efficacy" and it is an important cognitive variable used to explain personal factors in individual formative behavior and interactions with the environment (Lent et al., 2014; Sheu et al., 2014). Self-efficacy has been widely applied in the field of education to discuss students' psychological cognitive factors and the positive influence of their learning performance on career development. Contemporary studies hold that more research on the relationship between self-efficacy and learning performance improvement needs to be carried out (Tims et al., 2014). Tims et al. (2014) assert that when individuals have a high level of self-efficacy, they make more effort to obtain learning-related resources that can help them engage more deeply in learning (Bakker and Demerouti, 2014). It can thus be deduced that when students have a high level of self-efficacy, their learning engagement may be further improved. Based on the above, this study makes the following hypothesis:

H1: Self-efficacy is positively correlated with learning engagement.

Subjective Well-Being

Subjective well-being is consistent well-being or satisfaction that allows individuals to feel successful and deal with life pressure (Diener and Seligman, 2004; Huppert and So, 2013). Students' subjective well-being often involves the quality of school teaching and a positive emotional and cognitive evaluation of the school (Scrimin et al., 2016). Subjective well-being is critical to successful learning engagement among college students, because it promotes active learning, critical thinking, optimal performance, learning participation, and physical and mental health (Huppert and So, 2013; Steptoe et al., 2015). Given the situation resulting from the COVID-19 pandemic, in which colleges and universities in mainland China have

been using e-learning instead of traditional in-person teaching models for an extended period of time, students can perceive the more informal environment and are more self-centered (Tremayne et al., 2008). Student well-being has a positive impact on accepting new knowledge, facing new challenges, and maintaining learning motivation. Therefore, this study makes the following hypothesis:

H2: Subjective well-being is positively correlated with learning engagement.

Perceived Control

Teaching classroom control is often defined as a single dimension ranging from teacher control to student autonomy, as well as teacher and student control of learning (DeCharms, 1976). Classroom control depends on the teaching content and direction, as controlled by teachers, and the opportunities for self-directed learning for students (Bandura and Wood, 1989). Connell (1985) holds that perceived control could be improved by providing students with opportunities for choice and self-directed learning. Pintrich and de Groot (1990) believe that learning outcomes depend on students' view of organized teaching, their specific learning goals and clear explanations. Learning autonomy is the major determinant in ensuring sustainable self-control and improving learning performance (Connell, 1985; Pintrich and de Groot, 1990; Ames, 1992). There is no conflict, however, between giving more decision-making power to students in class and preserving the teaching responsibilities of teachers (Randi and Corno, 2000). Eckles (1993) found that low sense of control among students may have an adverse effect on their intrinsic motivation and academic performance. The expectation for gaining higher levels of inner achievement is therefore related to a higher degree of student control. When teachers do not share classroom decisions with students—that is, in teaching based on teacher control—students tend to avoid self-regulating strategies (Ryan and Grolnick, 1986; Eccles et al., 1993). Students who think they have no substantial control over their learning will show a lower level of response. Giving students the opportunity to make choices can enhance their intrinsic motivation and their engagement in learning (Ryan et al., 1985; Zimmerman and Kitsantas, 1999). We can thus infer that students have the highest self-recognition and self-efficacy when they perceive the classroom environment as being mainly student controlled. We thus propose the following hypothesis:

H3: Perceived control is positively correlated with self-efficacy.

According to theoretical and empirical research, perception of autonomous control promotes a higher level of well-being, because respondents with autonomous control can easily meet their basic psychological needs (Deci et al., 2001; Deci et al., 2006; Deci and Ryan, 2008). Decades of research have shown that perceived control is associated with motivation and various happiness indexes, such as the parent–child relationship (Clark and Ladd, 2000; Abad and Sheldon, 2008), and friendship (Demir et al., 2013). This idea has also been applied to the teacher–student relationship: students' perceived control has been shown to promote the internal perception of learning (Sheldon and Krieger, 2007; Filak and Sheldon, 2008; Overall et al., 2011; Bonneville-Roussy et al., 2013; Simon et al., 2015). For example, in a study on law school students, Sheldon and Krieger (2007) show that students who believe teachers support their choices in the classroom have a higher GPA, higher ABA scores, and more motivation for hunting jobs after graduation. In another study, Black and Deci (2000) show that the adoption of teaching strategies to promote student autonomy in class can support student success. Specifically, the students' perception of autonomous control from the teacher indicates inner satisfaction, increase of learning time, and a more comprehensive command of the entire curriculum knowledge. Based on this, we suggest the following hypothesis:

H4: Perceived control has a positive effect on subjective well-being.

Perceived Closeness

Perceived closeness is the sense of mutual trust and understanding generated from frequent interpersonal communication and pleasant interaction (Carey, 1986; Gremler and Gwinner, 2000; Frisby and Martin, 2010; Ryan et al., 2011). When being applied in the relationship between teachers and students, it is interpreted as "the results of communication with teachers perceived by students" (Frisby et al., 2014). Student self-efficacy in the teaching process depends on the individual characteristics of the teacher (Rots et al., 2002). Studies have shown that students have the greatest motivation when they perceive a positive correlation with teachers (Connell and Wellborn, 1991; Skinner and Belmont, 1993; Ryan and Deci, 2000). The relationship between students and teachers is an important predictor of subjective well-being (Aelterman et al., 2007). Building a strong supportive relationship with teachers makes students feel safer, more secure, and more capable in the school environment, thus affecting intrinsic motivation (Olivier and Archambault, 2017). The behavioral motivation of students is closely related to the teacher's ability to encourage cooperation. Such cooperation will also affect the teaching results, including the students' perception of themselves in class. This perception is obvious, especially in collective communication (McCroskey et al., 2006). Therefore, this study makes the following hypothesis:

H5: Perceived closeness has a positive effect on self-efficacy.

School is, in essence, a place of relationships. In this case, interpersonal relationships can have a positive or negative effect on student well-being (Bernard et al., 2007; Redmond et al., 2013). Kristja'nsson (2007) believes that affable people help to increase well-being by demonstrating lovely, positive, and good manners. Students value teachers who try hard to build relationships with them (Pomeroy, 1999; Sellman, 2009) and those who are "affable, smart, and interesting" (Hutchings et al., 2008). Teachers can thus carry out effective practice in class by promoting teacher–student interaction and striving to support students' social and affective functions. Studies have shown that students' well-being score is very low if their teachers show uncertainty and dissatisfaction when students

make presentations in class (Stevens and Sanchez, 1999; Holfve-Sabel, 2008). As Barton et al. (2000) emphasize, "Students generally spend a lot of time in school, and the quality of experience during the period of time with teachers is bound to affect emotional health." In the process of school teaching, students who are more emotionally connected with teachers show positive development trajectories in society and the academic sector (Ryan et al., 1994; Harter, 1996; Ladd et al., 1999; Roeser et al., 2000; Hamre and Pianta, 2001). This can also be extended to a more extensive educational background. For example, in an e-learning environment, teacher–student closeness will affect student well-being. Therefore, this study makes the following hypothesis:

H6: Perceived closeness has a positive effect on subjective well-being.

Peer Referents

Studies on point-to-point social impact in the student learning environment have shown that student characteristics and behavior tend to concentrate spatially and temporally (Aral and Walker, 2011). The mechanism for this is generally considered to be peer influence or peer referents (Turner, 1991). Some scholars have proposed that people will be positively or negatively evaluated based on the compliance of their behaviors to their role and surroundings (Eagly and Karau, 2002), so the influencing process on interactive behavior between peers cannot be ignored. Studies in the field of interpersonal relationships have repeatedly shown that peer referents play an important role in influencing perception and behaviors; the more individuals observe peers engage in a certain behavior, the more likely they are to engage in the same or similar activities (Beams et al., 2003; Bapna and Umyarov, 2015). If students observe that many peers are engaging in e-learning, they are more likely to engage in the same (Chen, 2008). In terms of online herd behavior, more peer referents tend to increase students' perception of themselves, and students further believe that their behaviors are recognized by their peers. Based on the above arguments, we make the following hypothesis:

H7: Peer referents have a positive effect on self-efficacy.

In a learning environment, peers have an obvious internal influence and may have an important influence on subjective well-being. Albanesi et al. (2007) propose that relationships between peers can predict students' social well-being, because references between peers are intuitive for students. For example, if most of your friends agree about an idea, you may feel obliged to show your agreement. When an individual compares his or her own behavior with that of a friend, subjective well-being will occur if his or her behavior is recognized by that friend (Lord and DeZoort, 2001). In e-learning lectures, if the understanding of knowledge a college student possesses is recognized by peers, a positive peer referent is generated. These referents are associated with student perception of well-being in the learning process. Grobecker (2016) believes that peer support has a positive impact on students' learning, motivation, and confidence, so it has a bearing on students' subjective well-being. All of these arguments indicate that peer referents may be an important prerequisite for perceiving well-being. Based on the above arguments, we make the following hypothesis:

H8: Peer referents have a positive effect on subjective well-being.

The S-O-R model can explain the willingness of students to engage in learning on their own initiative in the context of e-learning. To include the e-learning environment in the model as social environment stimuli, we assume that perceived control, perceived closeness, and peer referents are positively correlated with the self-efficacy and subjective well-being of students, which in turn affects learning engagement in the e-learning context. Based on this, we have interconnected the set of theoretical constructs in the S-O-R model and elucidated the underlying mechanisms in the research model (**Figure 1**).

METHODOLOGY

Data Collection

To contain the further spread of COVID-19, all colleges and universities in Mainland China have replaced traditional face-to-face teaching with e-learning in 2020. Since the purpose of this study is to explore the learning process and engagement of students brought by the changes in learning environment under the circumstances of the COVID-19 pandemic, purposive sampling is adopted to collect samples in line with this study. To make the samples meet the demands of the research model and research purpose, several conditions were set up in the sampling process. Firstly, the students should have the experience of offline classroom learning in the college and were not about to graduate, so the senior students were excluded and the sophomore and junior students were retained. Secondly, the multimedia tools used by students in online learning were mostly laptops or iPads, excluding students who use mobile phones. Thirdly, the hours for students taking multimedia tools for online learning should be at least 20 h per week. With the above three conditions, college students were taken as samples. This study takes college students as the research subject, selected four universities in Mainland China, and distributed 500 questionnaires. Questionnaires were distributed and collected in May and June 2020, and a total of 422 questionnaires were received. Of these, 45 questionnaires were eliminated due to questions that were not answered, so the valid questionnaires numbered 377, resulting in a valid response rate of 75.4%. Male students accounted for 46.8% of the respondents and female students for 53.2%; freshmen accounted for 35.6%, sophomores for 31.2%, and juniors for 33.2%; students majoring in social science accounted for 56.1%, and students majoring in natural science for 44.9%; students from public universities accounted for 69.4%, and students from private universities for 31.6%.

Instrument

To test the research model, a survey instrument was developed with each construct measured using multiple items. Most items were adapted from existing measures in the related literature

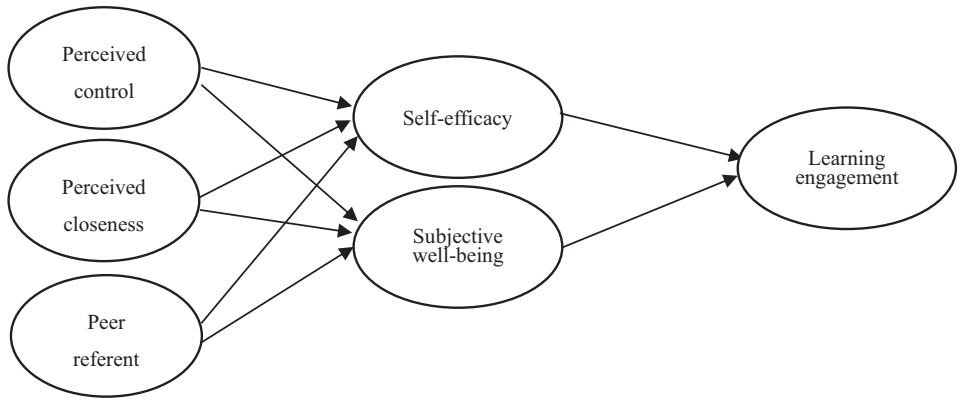

FIGURE 1 | Research framework.

with confirmed content validity and reliability, and then modified to fit our research context. Perceived closeness was measured by three items adapted from Ng (2013). Peer referents were measured by three items adapted from Eckles et al. (2005). For perceived control, an extended form of the Student Decision-Making Scale (Eshel, 1991) was employed. This scale presented a student perspective on shared control in class. For self-efficacy, four items were selected on the basis of prior scale and item analyses of Asian applications. Subjective well-being was measured using Keyes's (2005) subjective well-being instrument (adolescent version). All items were measured with a five-point Likert scale (1 = *totally disagree*; 5 = *totally agree*). All items of scales are shown in **Table 1**.

Because data were collected in China, translation and back-translation were adopted to ensure the translation quality. First, we consulted three professors of linguistics to understand the significance and readability of each item. The English questionnaire was then translated into Chinese with their help. Second, the Chinese questionnaire was translated into English by two Ph.D. candidates otherwise unconnected with this study. Third, we compared the translated items with the original items in English. To ensure the consistency of the two English versions, we improved the translation and eliminated all inconsistencies.

RESULTS

Evaluation of the Measurement Model

In our data analysis, we used partial least squares (Smart PLS 3.0), a variance-based latent variable structural equation modeling (SEM) technique. The primary advantages of PLS-SEM include the relaxation of normal distributional assumptions required by the maximum likelihood method used to estimate models using CB-SEM, as well as PLS-SEM's ability to easily estimate much more complex models with smaller sample sizes (Hair et al., 2019; Khan et al., 2019). The above reasons support the use of PLS at an appropriate SEM method for this study. Prior to evaluating the research model, we conducted several analyses to ensure that the latent constructs exhibited factorial validity and reliability. As shown in **Table 1**, all items show a high load for their relevant factors, but a low crossover load for other factors, indicating good convergence and discriminatory validity.

However, confirmatory factor analysis was carried out to evaluate reliability and validity. As shown in **Table 2**, Cronbach's α values ranged between 0.779 and 0.873, and the complex reliability (CR) values ranged from 0.858 to 0.913. All values are higher than the threshold value of 0.7, showing an adequate reliability. Moreover, the average variance (AVE) ranged from 0.604 to 0.725, which is higher than the suggested threshold value of 0.5. This indicates sufficient convergent validity (Fornell and Larcker, 1981). Third, this study compares the square root of the AVE and structural dependence to test the discriminant validity (Gefen and Straub, 2005). As shown in **Table 3**, all dependencies are lower than the square root of the AVE, showing a sufficient discriminant validity.

Testing Structural Model Fit

Before proceeding to examine the structural model, we first tested the model fit. Henseler et al. (2015) proposed three model fitting parameters: the SRMR, the normed fit index (NFI), and the exact model fit. According to Henseler et al. (2015), the evaluation standards for convergent validity are (1) NFI should be greater than 0.9, (2) SRMR should be less than 0.08, and (3) the exact model fit, which tests the statistical (bootstrap-based) inference of the discrepancy between the empirical covariance matrix and the covariance matrix implied by the composite factor model. Dijkstra and Henseler (2015) suggested the d_LS (squared Euclidean distance) and d_G (geodesic distance) as two different ways to compute this discrepancy. Henseler et al. (2015) indicated that dULS and dG were < the 95% bootstrapped quantile (HI 95% of dULS and HI 95% of dG). In this study, the SRMR value was 0.062 (<0.08), the NFI was 0.934 (>0.90), the dULS was < the bootstrapped HI 95% of dULS, and dG was < the bootstrapped HI 95% of dG, indicating the data fits the model well.

Structural Model Analysis

We used the SRMS criterion to evaluate the model's goodness of fit. In our examples, the SRMS is 0.062, lower than the 0.08

TABLE 1 | Items of scales.

Variable	Items	Factor loadings
Perceived control	In the course of online learning, I can think independently.	0.868
	In the course of online learning, I can take control of the learning content.	0.879
	In the course of online learning, I can control my own pace.	0.817
	In the course of online learning, I have class autonomy.	0.841
Perceived closeness	In the course of online learning, I feel a sense of closeness with teacher.	0.777
	In the course of online learning, I feel a sense of intimacy with teacher.	0.879
	In the course of online learning, my interaction with the teacher is different from that in offline classroom.	0.789
	In the course of online learning, I think I can talk to my teachers about anything.	0.834
Peer referent	In the course of online learning, I feel valued when I do things my classmates do.	0.821
	In the course of online learning, I feel approved when I do things my classmates do.	0.744
	In the course of online learning, I feel more personally accepted when I do things my classmates do.	0.780
	In the course of online learning, I do operations similar to my classmates.	0.831
Self-efficacy	In the course of online learning, I am competent to solve the problems of e-learning.	0.791
	In the course of online learning, when I come across problems, I can find solutions to them.	0.829
	I will try my best to achieve the online learning targets set by myself.	0.822
	I am well prepared to face and handle the demands of e-learning.	0.655
Subjective well-being	I feel cheerful.	0.872
	I find it interesting to study.	0.883
	I have confidence in my ideas and opinions.	0.876
	I think the society will be better.	0.763
Learning engagement	After taking course of online learning, I am willing to take the initiative to analyze problems.	0.848
	After taking course of online learning, I am willing to take effective learning.	0.863
	After taking course of online learning, I am willing to solve practical learning problems.	0.841
	After taking course of online learning, I am willing to engage in knowledge acquisition.	0.683

TABLE 2 | Measurement properties.

	1	2	3	4	5	6
1. Subjective well-being	0.850					
2. Peer referent	0.362	0.795				
3. Learning engagement	0.644	0.346	0.812			
4. Perceived control	0.483	0.303	0.420	0.851		
5. Perceived closeness	0.327	0.339	0.309	0.277	0.821	
6. Self-efficacy	0.532	0.473	0.466	0.424	0.265	0.777
α	0.807	0.806	0.826	0.873	0.838	0.779
AVE	0.722	0.632	0.659	0.725	0.674	0.604
CR	0.912	0.873	0.885	0.913	0.892	0.858

proposed by Henseler et al. (2016), indicating a satisfactory model fit. After evaluating that the measurement was satisfactory, we assessed the structural model. The hypotheses were examined by the percentage of variance explained and the significance of the structural paths. **Figure 2** and **Table 3** show the test result of the PLS analysis including control variables. Perceived control ($\beta = 0.298$, $p < 0.001$) and peer referents ($\beta = 0.363$, $p < 0.001$) are positively correlated with self-efficacy, so H3 and H7 are supported. However, perceived closeness ($\beta = 0.059$, $p = 0.258$) is not significant for self-efficacy, so H5 is not supported. Perceived control ($\beta = 0.156$, $p < 0.01$), perceived closeness ($\beta = 0.381$, $p < 0.001$), and peer referents ($\beta = 0.194$, $p < 0.01$) have a significantly positive correlation with subjective well-being; thus, H4, H6, and H8 are supported. Self-efficacy ($\beta = 0.172$, $p < 0.01$) and subjective well-being ($\beta = 0.553$, $p < 0.001$) are positively correlated with learning engagement, so H1 and H2 are supported.

DISCUSSION

The results of this study indicate that a harmonious relationship between teachers and students, peer referents among students, and student autonomous control over teaching contribute a lot to the learning engagement of students. With Chinese college students as the research sample, an empirical study was carried out to explore the dependence relationship between perceived closeness, perceived control, peer referents, self-efficacy and subjective well-being, and learning engagement using the S-O-R model. This study fills the theoretical gap in terms of research on student learning engagement in the e-learning context and will enhance theoretical generalizations.

Based on our findings, this study aims to make the following contributions. First, few studies have confirmed the influence of stimulating factors in e-learning environment on students' learning engagement. This study used the COVID-19 pandemic as the research background, discussed learning engagement among college students in the long-term e-learning process, and attempted to provide practical inspiration for schools to carry out more e-learning practices in the future. Second, most of the previous studies on the S-O-R model focused on the importance of external environmental stimuli, but few studies have analyzed

TABLE 3 | Results of the hypotheses testing.

Hypotheses	Std. β	*t* value	Significance CI (2.50–97.5%)	VIF	f^2
Direct paths					
H1: Self-efficacy → learning engagement	0.172**	3.316	(0.070∼0.276)	1.395	0.038
H2: Subjective well-being → learning engagement	0.553***	12.481	(0.461∼0.634)	1.395	0.388
H3: Perceived control → self-efficacy	0.298***	5.302	(0.188∼0.410)	1.144	0.113
H4: Perceived control → subjective well-being	0.381**	7.680	(0.056∼0.257)	1.144	0.183
H5: Perceived closeness → self-efficacy	0.059	1.140	(-0.038∼0.159)	1.174	0.004
H6: Perceived closeness → subjective well-being	0.156***	3.046	(0.056∼0.257)	1.174	0.030
H7: Peer referents → self-efficacy	0.363**	6.822	(0.257∼0.467)	1.194	0.161
H8: Peer referents → subjective well-being	0.194**	3.413	(0.084∼0.304)	1.194	0.045

$^{**}p < 0.01$, $^{***}p < 0.001$.

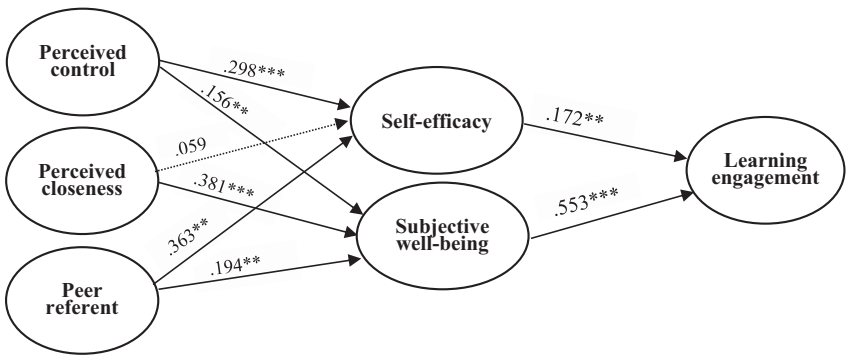

FIGURE 2 | Structural model. $^{**}p < 0.01$ and $^{***}p < 0.001$.

the role of specific factors in e-learning. This study aimed to fill this gap and enrich the applications of the S-O-R model. Third, in addition to verifying the research framework established by the S-O-R model, this study also focused on the perspective of e-learning. Our research findings will provide more insights and suggestions for e-learning management.

The results of this study show that perceived closeness, perceived control, and peer referents are positively correlated with subjective well-being. This signifies that, in the e-learning context, students' participation in and control of the teaching process, their high closeness with teachers, and their mutual recognition and behavioral referents with peers will make students feel satisfied and thus produce learning-related well-being. The close relationship between teachers and students is one of the main factors affecting the psychological status of students, which is consistent with the results of previous research (Richmond et al., 2015; Rogers, 2015). Perceived control and peer referents are positively correlated with self-efficacy. In other words, students perceive higher self-efficacy when students think that the teacher has given them more freedom to make choices in class. In addition, the mutual effect and synchronized behavior of peers is also an external influencing factor that has a positive effect on students' internal self-efficacy. This study also found that self-efficacy and subjective well-being are positively correlated with learning engagement. This is in line with prior findings; for example, Bandura and Wood (1989) stress the importance of self-efficacy for changing and using capabilities, which is one of the factors for improving academic performance. The results of this study are consistent with the view of self-learning, indicating that learners with learning characteristics of self-regulation have more positive and active learning styles, who can set practical and feasible learning targets according to their own learning, recognize available resources, choose proper learning strategies, and can evaluate their own learning achievements (Bembenuty, 2011).

However, we also found that the relationship between perceived closeness and self-efficacy was not supported. Previous studies have put forward that this close relationship is one of the most significant factors that influence courses (Richmond et al., 2015; Rogers, 2015). The influence of this kind is not necessarily positive. In e-learning, changes in the learning environment and a long stay at home inevitably cause learning difficulties. Thus, when teachers have a harmonious relationship with students, students tend to depend on their teachers, thinking that teachers will recognize the learning difficulties and tolerate their inertia, which ultimately negatively affects their self-efficacy.

Practical Implications

According to our findings, this study has important practical significance for learning engagement among college students in the e-learning context. A close relationship between teachers and students, students' autonomous control over class, and mutual support and referents among peers are considered predictive factors for self-efficacy, subjective well-being, and learning engagement. External environmental stimuli have an

effect on psychological status and help students gain more positive inner feelings, so they can be regarded as an essential condition for improving student learning engagement. Teachers should focus on motivating students to engage in learning on their own initiative while asking them to achieve goals. We therefore make the following suggestions for long-term study at home during the global COVID-19 pandemic. First, teachers should be encouraged to grant students more control over their learning, provide a more active online teaching atmosphere, add relevant applied technologies, and enhance students' sense of participation and control in class. Some studies have indicated that teachers play an important role in guiding students to control their learning (Zimmerman et al., 1996). Thus, schools should provide teachers with brief training courses on how to promote these techniques in e-learning.

Second, teachers should support communication among students in the e-learning environment. Students are prone to be affected by the ideas of their peers, so teachers should increase opportunities for communication among students, creating a learning and social environment that is conducive to relationship maintenance and strengthens interaction. Moreover, providing more interfaces and functions for interaction and communication among students can also be introduced to the online teaching platform. Our findings not only can enrich the research on student interaction in e-learning but also can help teachers and platforms that provide online courses in the future.

Third, teachers should develop good teacher–student relationships. This study suggests that teachers also need to state course requirements and objectives clearly to students while creating a close relationship to reduce environmental barriers. Teachers should pay close attention to the subtle changes in the teacher–student relationship in the network environment and observe the mental and learning states of students while teaching. Teachers should have a definite attitude toward student inertia and contain the development of adverse mental states in a timely manner.

Research Limitations

Our research findings will enrich the literature on learning engagement, the S-O-R model, and e-learning environments. Nevertheless, some limitations exist and represent further research directions. First, although the S-O-R model has achieved a remarkable position in the field of psychology, only a few studies have focused on the relationship between stimulating factors in the e-learning environment and learning engagement among college students. This study builds the constructive mechanism for learning engagement in the e-learning environment based on the S-O-R model (perceived closeness, perceived control, and peer referents) and extracts important learning theories, but considering the unique, long-term, and large-scale e-learning environment generated by the COVID-19 pandemic, future research should test the model under different scenarios, such as e-learning as a supplement to face-to-face instruction.

Second, the data used in this study came from courses for a medium number of students (40–70 students), and no typical large-scale courses for audiences in the hundreds were involved. Thus, it remains to be seen whether student control over courses, harmonious teacher–student relationships, and extensive peer referents in e-learning for a larger number of students can bring similar benefits.

Third, the sample in this study may not accurately represent all student groups due to the restrictions of time and space. Thus, future research should include and compare different ethnic and cultural groups to provide additional opinions on e-learning, in addition to expanding the sample size and improving the research representativeness.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board, Yango University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

This study is a joint work of the four authors. JY and MP contributed to the ideas of educational research, collection of data, and empirical analysis. MP, SW, and WC contributed to the data analysis, design of research methods, and tables. MP, SW, WC, and JY participated in developing a research design, writing, and interpreting the analysis. All authors contributed to the literature review and conclusions.

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Teachers' Perception of Student Coping With Emergency Remote Instruction During the COVID-19 Pandemic: The Relative Impact of Educator Demographics and Professional Adaptation and Adjustment

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The outbreak of the COVID-19 pandemic has upended lives and thrown the taken for granted into disarray. One of the most affected groups were teachers and students, faced with the necessity of school closures and—where logistically feasible—an urgent shift to emergency remote instruction, often with little prior notice. In this contribution, based on an online survey involving participants from 91 countries, we offer a perspective bridging the two groups, by investigating the role of teachers' demographics and professional adaptation to emergency remote teaching in their perception of how their students were coping with the novel situation. The resultant model explains 51% of variance, and highlights the relative weights of the predictor variables. Given the importance of teacher perceptions in the effectiveness of their instruction, the findings may offer valuable guidelines for future training and intervention programs.

Keywords: educational psychology, COVID-19 pandemic, evaluation, emergency remote teaching, school closure, distance learning, perception of student coping, professional adaptation

INTRODUCTION: BACKGROUND LITERATURE

In the wake of the COVID-19 pandemic, early 2020 saw a global suspension of face-to-face classes and large-scale school closures in an attempt to curb the viral transmission, impacting over 90% of the world's student population (UNESCO, 2020). In order to ensure continuity of education, where logistically possible institutions transitioned to emergency remote instruction, usually with little time given for preparation. The transition and implementation of the new teaching and learning format have posed numerous risks, problems, and challenges to both teachers and students (Bao, 2020; Cachón-Zagalaz et al., 2020; Hiraoka and Tomoda, 2020).

Current scholarship on emergency remote instruction during the COVID-19-induced school closures tends to focus either on teacher or student populations. The University of Houston's (2020) report summarizing the faculty's perceptions regarding the transition revealed significant variation

in terms of the implementation of technology tools and of the mode of instruction. A survey by Quality Matters and Eduventures® Research (Legon et al., 2020) carried out among chief online officers at colleges and universities reported that while most believed the pivot to remote teaching to be a logistic success, most simultaneously admitted at least a measure of difficulty, citing low levels of faculty and student preparedness. A report published by Ohio State University (Jaggars et al., 2020, p. 25) discovered among others that faculty who taught their courses in real-time rated online teaching challenges less negatively than those who used an asynchronous delivery format. A survey deployed by eLearning Researc Practice Lab Indiana University Pervasive Technology Institute (2020) found that two-thirds of the instructors felt disconnected from their students and that it was more difficult to teach, while three quarters of the students felt they had lost touch with their IU community; a similar number declared it took them more effort to complete their course assignments after the transition. A study carried out among university students at a Greek university (Karalis and Raikou, 2020) found that the majority of the students surveyed experienced negative emotional states such as stress, anxiety, and sadness at the announcement of university closure, but that these decreased once online classes had started. Thematic analyses of the responses revealed the important role of the teachers in this positive shift. Watermeyer et al. (2020) found that the majority of the academic teachers in their sample felt confident or strongly confident in their ability to carry out online teaching and assessment, and considered their institutions to be supportive in facilitating the move to online delivery. Li et al. (2020) assessed the impact of the outbreak on stress, poor mental health, and poor sleep quality symptoms among college students in Guangdong. Wilczewski et al. (2021) investigated the psychological and academic effects of learning online among international students enrolled at the University of Warsaw. Alemany-Arrebola et al. (2020) analyzed the impact of trait- and state-anxiety on university students' perception of academic self-efficacy in Spain. Zaccoletti et al. (2020) investigated the decrease in Italian and Portuguese primary and lower secondary school pupils' motivation from the perspective of the parents.

A sudden forced transition to remote teaching constitutes an important factor that may influence students' handling of this unprecedented educational challenge, as well as teachers' perception of students' coping with remote learning. Perceptions of students' abilities guide teachers' choices of instructional methods (Biddle and Anderson, 1986; Snow, 1994; Martin, 2006; Hardré and Sullivan, 2009; Cho and Shim, 2013). Those who perceive their students' achievement, motivation, work habits, and class activity negatively have lower learning expectations (Rubie-Davies, 2010). Highly consequential for the efficiency of the teaching process and student achievement is also teachers' perception of their own competencies (Tucker et al., 2005; Guo et al., 2012; Miller et al., 2017). Numerous studies indicated that teacher self-efficacy positively influences beliefs about teaching (Tschannen-Moran and Woolfolk-Hoy, 2001; Skaalvik and Skaalvik, 2007; Cho and Shim, 2013), modes of instruction, and students' outcomes (Zee and Koomen, 2016). Teachers' perception of their own self-efficacy is also related to how they meet obstacles and challenges (Pajares, 1996; Tschannen-Moran et al., 1998; Woolfolk Hoy et al., 2005). Instructors who feel more efficient and competent themselves set higher expectations for their students (Midgley et al., 1995; Wolters and Daugherty, 2007; Cho and Shim, 2013), but simultaneously are more positive and responsive to them (Gibson and Dembo, 1984) and tend to provide them with more support promoting a good learning atmosphere (Bru et al., 2002; Rubie-Davies, 2007, 2010; Sakiz et al., 2012; Holzberger et al., 2013, 2014; Guo et al., 2014).

The results of the above studies refer to the educational process under normal conditions of on-site and face-to-face classes. Little is known about whether they will be replicated in the case of emergency remote teaching. Existing studies concerning online teaching or learning focus mainly on identifying the most significant technical skills such as those needed to use the specific software application, or on dealing with difficulties with particular software and using it in student assessment of learning, as illustrated for instance in Hampel and Stickler's (2005) skills pyramid (see also Livingston and Condie, 2006; Compton, 2009). However, research has not yet attempted to investigate how teachers' circumstances, behaviors, and attitudes affect their perception of students' coping with online delivery. Moreover, remote learning entails specific problems that may influence teaching and learning quality and effectiveness, such as the deficit of "live," "face-to-face" contact felt by both students and teachers (e.g., Stodel et al., 2006; Arroyo et al., 2015; Barnard-Ashton et al., 2017; Janse van Rensburg, 2018;[1]); lack of adequate technological affordances to efficiently deliver the program, provide support to participants, and satisfy their learning needs; and inadequate teacher and student competencies to use the technological solutions (Garrison et al., 1999; Pawan et al., 2003; Livingston and Condie, 2006). These deficits can result in increased feelings of insecurity, confusion, and threat among learners, as well as feelings of doubt and fear of failure among teachers (Arroyo et al., 2015; Janse van Rensburg, 2018) influencing how they perceive their students and, in consequence, how they teach them.

Thus, teachers' sense of competence, which is related to the notion of self-efficacy (Bandura, 1997), may facilitate adaptation, enhancing their ability to deal with challenges and difficulties related to this novel teaching context. It may also be linked to the degree to which the teachers support their students in the new learning context as well as in the COVID-19 pandemic social context, if it shapes expectations toward the students, adjustment of instruction to this new situation and the students' abilities, evaluation of their activity, as well as potential difficulties with assessment. All these factors seem to be related to if not determine how teachers perceive students' coping during the transition to remote instruction. The social projection hypothesis (Krueger and Acevedo, 2005; Krueger et al., 2006; Krueger, 2007) permits the conjecture that teachers' own sense of competence and how they cope in this particular educational context as well

[1] Jeliska, M., and Paradowski, M. B. (under review). The impact of demographics, life and work circumstances on college and university instructors' well-being during quaranteaching: findings from a global survey. *Front. Psychol.*

as their satisfaction with remote teaching and perception of its effectiveness may be automatically projected onto and attributed to students.

The aim of this study is thus to investigate the ways in which teachers' perception of how their students were coping with the novel situation was affected by their professional adaptation to emergency remote teaching (ERT; Hodges et al., 2020), following the social projection hypothesis (Krueger and Acevedo, 2005; Krueger et al., 2005; Krueger, 2007), as well as sociodemographic variables. The study is guided by the following exploratory research questions:

RQ1: To what extent—if any—does teachers' perception of students' coping vary depending on sociodemographic factors such as (1a) teachers' gender, (1b) teachers' age, (1c) length of teaching experience, and (1d) level of education handled?
RQ2: To what extent—if any—does teachers' perception of students' coping vary depending on their attitudes toward remote teaching based on (2a) perception of remote teaching effectiveness, (2b) prior experience with remote instruction, (2c) mode of remote instruction, i.e., synchronous vs. asynchronous classes, and (2d) appraisal of the relative situational impact on teachers and students (i.e., whether one of these group is more affected)?
RQ3: Which of the indicators of teachers' professional adaptation to emergency remote instruction are associated with teachers' perception of student coping with online classes, and to what extent?
RQ4: Which of the indicators of teachers' professional adaptation to emergency remote instruction predict their perception of student coping with online classes?
RQ5: What is the relative contribution of the respective predictors and to what extent does each of them determine teachers' perception of student coping with online classes? Which of them have the greatest influence on how teachers perceive their students' learning?

To this end, from April until September 2020, we carried out a custom-made multinational survey.[2]

MATERIALS AND METHODS

Participants

From April through September 2020, a total of 6,582 educators participated in a study probing teachers' adaptation to emergency remote instruction during the COVID-19 epidemic. Of these, 1,944 completed the questionnaire and met the inclusion criteria. Approximately 40% represented higher education institutions, teaching at a university, graduate school, or community college; 24.3% taught at secondary and 29.2% at K-primary education levels. The teachers came from 6 continents and 91 countries and autonomous territories, with almost equal proportions representing Europe (41.6%) and North America (40.6%). Their reported mean age was 43.6 years (SD = 11.9). More than half (51%) were aged between 25 and 45; 44% declared to be over 45 years old; 83% were female.

Most of the participants had been teaching their subject for more than 5 years. Almost 62% declared to teach classes in real time (synchronously) during the COVID-19 pandemic, although as many as 79.1% had no prior experience with this mode of instruction. More than 62% of all the respondents found remote teaching (whether synchronous or asynchronous) less effective than face-to-face classes; 53.2% estimated that the pandemic situation had affected teachers and students equally, whereas 33.1% found students to be in a worse situation than the teachers. The participant sociodemographics are presented in **Table 1**.

Measures

To verify how teachers adapt to and cope with emergency remote teaching, we designed a custom-made online survey (see **Supplementary Material**). It comprised 441 items concerning respondents' sociodemographics, the circumstances surrounding their transition to emergency remote instruction, personal experiences, behaviors, attitudes, feelings, physical and mental health, as well as their personality traits. Psychological constructs were measured with 23 short scales developed from IPIP items and inspired among others by in-depth analyses of Brief COPE (Carver, 1997), Life Orientation Test—Revised (Scheier et al., 1994), Five-Dimensional Curiosity Scale Revised (5DCR; Kashdan et al., 2020), Individual Adaptability I-ADAPT-M (Ployhart and Bliese, 2006), and Grit Scale (Duckworth et al., 2007). Due to the rather general nature of these existing questionnaires, which does not permit capturing more situation-oriented circumstances, we developed custom-made scales, single-item indicators, as well as open-ended questions. The content of these items was consulted with academics with experience in the field and discussed/piloted with teachers and students.

In this article, to analyze how teachers' professional adaptation to emergency remote instruction contributes to their perception of student coping, we focus on five short scales and nine specific single-item indicators complemented by sociodemographic factors such as gender and education stages handled. Two of the designed scales assessed aspects of teacher adaptation to ERT such as adjustment of instruction and evaluation uncertainty/issues, one scale measured perceived student coping, whereas the other two scales investigated self-perception of supportive teaching and sense of competence.

Instructional adjustment was measured with three items assessing the extent to which the respondents had modified their teaching mode and material (e.g., "During this epidemic, I have felt that I have to alter not just the medium and method, but also the content of my classes") as well as changed their evaluation (e.g., "I have eased the grading scheme"). The items in this and all the remaining scales were answered on a six-point Likert scale ranging from 1 (completely disagree) to 6 (completely agree). The internal consistency of this scale was satisfactory (Cronbach's $\alpha = 0.70$, McDonald's $\omega_h = 0.68$, Guttman's $\lambda_6 = 0.59$, Reykov's $\rho = 0.89$).

Evaluation uncertainty was measured with a three-item scale assessing the extent to which teachers experienced difficulties in

[2]The data presented in this paper come from a larger project https://schoolclosure.ils.uw.edu.pl/.

evaluating students' activity (e.g. "I find it difficult to evaluate students' activity during online classes") and verifying progress ("I am unable to verify whether the students are learning") as well as doubts about the integrity of the assignments and examinations ("I am anxious that some students may be using the situation to cheat in their assignments/exams"). In the current study, its internal consistency reached Cronbach's α of 0.73, McDonald's $\omega_h = 0.75$, Guttman's $\lambda_6 = 0.68$, and Reykov's $\rho = 0.98$.

Perceived student coping was assessed with four items measuring teachers' perception of the extent to which students coped with the transition to remote learning (e.g., "I feel that some of my students have been left behind/fallen through the cracks in the shift to remote teaching"), reacted positively to remote teaching ("My students have responded positively to my remote teaching"), and experienced difficulties such as lack of concentration and/or attention ("The students have trouble with concentration and staying focused during the online classes"). Three of the items were reverse worded, indicating issue occurrence. The scale reported a satisfactory internal consistency of Cronbach's $\alpha = 0.72$, McDonald's $\omega_h = 0.74$, Guttman's $\lambda_6 = 0.69$, and Reykov's $\rho = 0.94$.

Supportive teaching was measured with a five-item scale gauging to what extent teachers perceived themselves as motivating ("I can talk my students into learning"), supporting students' activity ("I am good at helping people work well together"), inclusive ("I try to make sure everyone in a group feels included"), building their relation with the students/class on trust and security ("I trust my students"), as well as fostering student well-being ("I try to make my group members happy"). The scale showed good internal consistency of Cronbach's α, McDonald's ω_h and Reykov's $\rho = 0.73$, and Guttman's $\lambda_6 = 0.71$.

Sense of competence was measured with an eight-item scale assessing the extent to which teachers felt they had knowledge and skills necessary to face challenging or demanding tasks (e.g., "I know how to get things done" and "I like to work on tasks that require a great deal of skill"), preparedness (e.g., "I am always prepared"), having multitasking ability ("I can manage many things at the same time"), being tech-savvy ("I am a confident user of new technologies"), and lifelong training in their professional skills ("I continually train to keep my teaching skills and knowledge up-to-date"). In the current study, the scale reported good internal consistency of Cronbach's α and McDonald's $\omega_h = 0.76$, Guttman's $\lambda_6 = 0.74$, and Reykov's $\rho = 0.67$ and correlated positively with supportive teaching ($r = 0.47$, $p < 0.05$).

The scales were distinguished on the basis of exploratory factor analysis (EFA) preceded by an analysis of inter-item correlations. As the criterion for item selection, we followed the recommendation by Clark and Watson (1995) that items should ideally correlate between 0.15 and 0.50. Using maximum likelihood estimation with standardized varimax rotation, we identified five factors with eigenvalues exceeding 1.0 (from 4.4 for the first factor to 1.04 for the fifth factor). All loadings but two were greater than 0.40. All the factors accounted for 52% of total variance explained. The EFA factor loadings of all the items are presented in **Appendix Table 6a**. The model of these scales was subsequently validated through confirmatory factor analysis (CFA) using the SEPATH module in the STATISTICA software. For this purpose, we applied the maximum likelihood method, which resulted in the same five-factor structure. The comparative fit index (CFI; Bentler, 1990) estimates how much the non-centrality parameter is reduced when moving from an unstructured baseline model (i.e., one with the worst fit) to the considered model. Values of at least 0.90 indicate a good fit of the model. The root mean square error of approximation (RMSEA) based on the non-centrality parameter estimates the difference between the hypothesized model and the perfect model. A well-fitted model is indicated by values lower than 0.05 (Browne and Cudeck, 1993). The standardized root-mean-square residual (SRMR) reflects the discrepancy between the reproduced and the observed correlations. As the cutoff criterion, Hu and Bentler (1998) recommended a value of 0.08, with higher values indicating poorer fit to the data and values lower than 0.05 indicating an excellent fit. Both RMSEA and SRMR are the absolute fit indices. In this study, the CFA fit indices indicated satisfactory fit for the model: $\chi^2(220) = 352.74$, $p = 0.001$—given that χ^2 is highly sensitive to large sample sizes and leads to the rejection of models with the simplest misspecification, we also examined the goodness-of-fit index GFI = 0.900, CFI = 0.904, RMSEA = 0.046, and SRMR = 0.061. They provided confirmatory evidence for the factor structure.

The single-item indicators were used to assess other aspects related to educators' perception of the students during the remote teaching period, such as *student activity evaluation* ("Thanks to the change, some students who used to be passive have now become more active") and *overly demanding expectations* ("Now my students ought to be able to do more because they have more time"). They also allowed measuring COVID-19 situation-related aspects of teaching such as *reassuring attitude* ("I try to reassure my students during these times"), *perceived initial ability to teach remotely* ("I felt confident in my ability to teach remotely when I was told to do so"), *prior experience with remote teaching* ("I had been teaching e-learning, blended courses, MOOCs or webinars before this epidemic"), and *mode of remote instruction* (synchronous vs. asynchronous). Finally, some single-item indicators were used to measure *perceived remote teaching effectiveness*, *satisfaction with online teaching software/solutions* ("Do you like the tools/software/platform you have been using to teach the online classes?"), and the *appraisal of the relative situational impact* of the COVID-19 pandemic on teachers and students in the educational context. This item measures instructors' perception of how the situation influences different stakeholders of the education process: as affecting teachers more than students, students to a greater extent than teachers, or influencing both groups to a similar extent. In addition to single-item indicators, we took into account basic sociodemographic information such as teachers' age, gender, and education stage handled.

One-item measures are often criticized for their low reliability and estimation difficulty, as well as vulnerability to the response style effect compared with longer scales, but these arguments are not always sufficiently justified (Wanous and Reichers, 1996; Konstabel et al., 2012; Jovanović and Lazić, 2020).

In psychometric theory, the longer the scale, the lower the measurement error and thus the higher scale reliability. However, with an increasing number of items, respondents may pay decreasing attention to their responses, which reduces the quality of the information obtained (Gogol et al., 2014). Moreover, Wanous and Reichers (1996) proposed a procedure based on a formula for the correction for attenuation which allows measuring the reliability of single-item indicators. In this study, we applied the comprehensive single item approach (CSI) proposed by Konstabel et al. (2012, 2017). The CSI assumes that the content validity of a one-item indicator is preserved when this item has a comprehensive content and is newly written instead of being selected from a longer scale. This approach is based on the assumption that every individual has self-knowledge and is able to characterize it if a given construct is substantially simple, unambiguous, or narrow to be comprehensible to the respondent (Wanous and Reichers, 1996; also Loo, 2002). This means that the CSI should not be applicable to more complex traits or dispositions. Thus, in this research, it was only employed with general and more homogeneous variables. Numerous single-item measures have successfully been used in studies measuring self-esteem (Robins et al., 2001), self-efficacy (Hoeppner et al., 2011), job satisfaction (Wanous et al., 1997; Nagy, 2002), burnout (West et al., 2012), psychosocial stress (Littman et al., 2006), life satisfaction (Jovanović and Lazić, 2020), the need to belong (Nichols and Webster, 2013), ability ratings (Rammstedt and Rammsayer, 2002), and even personality facets (Rammstedt and John, 2007; Denissen et al., 2008; Konstabel et al., 2017). In the field of education, they have been used to measure teaching effectiveness (Wanous and Hudy, 2001), academic anxiety and academic self-concept (Gogol et al., 2014), among others. Single-item indicators are appreciated as they allow reducing survey time, are highly flexible, easily adjust to new contexts, and yield more generalizable research results that are easier to interpret. They also protect against item redundancy, which may evoke respondent frustration, mental fatigue, and boredom (Nagy, 2002; Konstabel et al., 2012, 2017; West et al., 2012; Gogol et al., 2014). Gardner et al. (1998) posit that in some contexts single-item general indicators of psychological constructs may be better than a set of responses to numerous construct facets. They are particularly useful in large-scale surveys that cover numerous variables (Nagy, 2002; Konstabel et al., 2012, 2017; West et al., 2012).

Procedure

The custom-made questionnaire was active from April until September 2020 on a commercial survey software platform (in order to facilitate responses from countries where solutions such as Google Forms are inaccessible without a VPN). The participants were recruited based on a snowball sampling technique using several channels including the researchers' direct personal contacts, mailing lists and websites of professional associations, as well as thematic groups and pages on social media. The respondents were informed about the purpose of the survey and they participated voluntarily. The protocol had received IRB approval.

A prerequisite to take part in the study was having transitioned from regular face-to-face classes to online teaching as part of the response to the COVID-19 epidemic. The opening filter question excluded more than 13% of the initial survey takers, who either continued teaching face-to-face or had already been teaching online before the school closures happened.

Data Analysis

In order to answer RQs 1a–d and 2a–d, the relationships between the variables, based on the significant differences, were analyzed on the basis of independent-sample t tests and one-way ANOVAs. To find the answer to RQ3, continuous variables were characterized by means of Pearson's correlation coefficient and categorical variables by Spearman's ρ. To verify the predictors of perceived student coping with remote teaching, we used STATISTICA's General Regression Models (GRM) module applying the methods of the general linear model, which allows building models combining categorical and continuous predictor variables (analysis of covariance design). In contrast with (multiple) regression models applicable only to continuous variables, the general linear model permits the analysis of any ANCOVA or MANCOVA design that includes both categorical (e.g., gender) and continuous predictor variables as well as a wide variety of different types of design. Analysis of covariance (ANCOVA) is defined as a general linear model, and combines at least one categorical predictor (one-way ANOVA) and continuous predictors (linear regression). In all general linear models, the dependent variable(s) is/are always continuous. As in the case of regression, the use of ANCOVA depends on five assumptions: normality of residuals, homogeneity of variance, homogeneity of regression slopes, linearity of regression, and independence of error terms (Garson, 2012; Philippas, 2014). In this study, a general linear model was the most suitable statistical tool to find the answers to RQ4, allowing to take into account both categorical and continuous predictors. The answer to RQ5 utilizes forward selection, based on adding the most statistically significant variables to the model until there are no more such variables meeting the entry criteria and a satisfactory regression equation has been found. The significance level was set at 0.001 for ANCOVAs and at 0.05 for the remaining analyses. Effect sizes are reported with Cohen's d for the t test and η_p^2 for ANOVA, respectively.

The linearity assumption was examined via a visual inspection of scatterplots showing that the variables and the residuals of the regression (i.e., the errors between the observed and the predicted values) were normally distributed. The variance inflation factor (VIF) not exceeding 1.6 and tolerance ranging from 0.64 to 0.94 indicated lack of multicollinearity. The lack of collinearity was also confirmed by a matrix of Pearson's bivariate correlations among all the predictors. A visual analysis of a scatterplot of residuals vs. predicted values indicated that the assumption of homoscedasticity was satisfied as well.

RESULTS

To answer the first two research questions, i.e., whether and to what extent teachers' perception of students' coping varied

TABLE 1 | Sociodemographic characteristics of the participants ($N = 1,944$).

	Frequency (*n*)	Percent (%)
Stage of education handled		
K-primary	568	29.2
Secondary	472	24.3
Tertiary	772	39.7
Other	27	4.2
Not reported	51	2.6
Continent		
Europe	809	41.6
(Austria, Belgium, Belarus, Bulgaria, Czech Republic, Croatia, Cyprus, Denmark, Finland, France, Georgia, Germany, Greece, Hungary, Ireland, Italy, Jersey, Lithuania, Luxembourg, Malta, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland, United Kingdom, and Ukraine)		
North America	789	40.6
(Bahamas, Canada, Costa Rica, Mexico, Puerto Rico, and USA)		
Asia	200	10.3
(Bahrain, Bangladesh, Brunei, Cambodia, China, Hong Kong, Macao, India, Indonesia, Iraq, Israel, Japan, Jordan, Kuwait, Laos, Lebanon, Malaysia, Nepal, Oman, Pakistan, Palestine, Philippines, Qatar, Saudi Arabia, South Korea, Sri Lanka, Taiwan, Thailand, Turkey, United Arab Emirates, and Vietnam)		
Oceania	72	3.7
(Australia, Fiji, Kiribati, and New Zealand)		
South America	38	2.0
(Argentina, Brazil, Chile, Colombia, Peru, Trinidad and Tobago, and Uruguay)		
Africa	36	1.9
(Algeria, Egypt, Kenya, Lesotho, Malawi, Mauritius, Morocco, Senegal, South Africa, and Tunisia)		
Age groups (years)		
<25	95	4.9
25–35	397	20.4
36–45	595	30.6
46–55	533	27.4
56–65	282	14.5
>65	40	2.1
Not reported	2	0.1
Gender		
Female	1,610	82.8
Male	320	16.5
Not listed/non-binary	14	0.7
Experience teaching the subject		
<5 years	615	31.6
6–15 years	620	31.9
16–25 years	473	24.3
26–35 years	178	9.2
>35 years	57	2.9
Not reported	1	0.1
Remote teaching mode		
Synchronous	1,202	61.8
Asynchronous	742	38.2
Prior experience with remote teaching		
Lack of experience	1,537	79.1
Prior experience	407	20.9
Perceived effectiveness of remote teaching vis-à-vis F2F instruction		
Less efficient	1,217	62.6
Equally efficient	526	27.1
More efficient	201	10.3
Appraisal of relative situational impact		
Students affected more than teachers	644	33.1
Teachers and students affected equally	28	53.2
Teachers affected more than students	113	5.8
Not reported	153	7.9

depending on sociodemographic factors such as (1a) gender, (1b) age, (1c) length of teaching experience, and (1d) education stage handled as well as whether and to what extent it varied depending on the teachers' attitudes toward remote teaching based on (2a) perception of remote teaching effectiveness, (2b) prior experience with remote instruction, (2c) mode of remote instruction, i.e., synchronous vs. asynchronous classes, and (2d) appraisal of the relative situational impact on teachers and students (i.e., whether one of these group was more affected), we calculated Student's *t* test and ANOVA, respectively. **Table 2** presents significant differences for teachers' perception of student coping with remote learning. The results indicate that the teachers differed in their perception among several dimensions.

Male teachers felt that students coped better ($M = 3.42$, $SD = 1.07$) compared with their female counterparts ($M = 3.20$, $SD = 1.01$). Differences also occurred across all three education stages: primary ($M = 2.87$, $SD = 0.99$), secondary ($M = 3.04$, $SD = 0.96$), and tertiary ($M = 3.58$, $SD = 0.96$).

Perception of student coping was also influenced by perception of remote teaching effectiveness. Those who found their remote instruction to be less efficient than face-to-face classes were convinced that students experienced more difficulties while learning online ($M = 2.88$, $SD = 0.89$), whereas their colleagues who estimated remote teaching as equally or more efficient did not deem it more difficult for their students ($M = 3.85$, $SD = 0.90$ and $M = 3.83$, $SD = 1.07$ respectively).

Student coping was also perceived differently among teachers who conducted synchronous and asynchronous classes. The former found students to cope better ($M = 3.48$, $SD = 1.00$), compared with teachers who did not teach in real time ($M = 2.85$, $SD = 0.95$).

Finally, differences in perception of student coping were also related to educators' prior experience with remote instruction. Teachers who had taught remotely before the pandemic

TABLE 2 | Significant differences in teachers' perception of student coping with remote learning ($N = 1,944$).

	Perceived student coping						
	M	**SD**	**Effect size**	**95%CI**		***F* or *t***	**df**
Gender			**$\eta_p^2 = 0.006$**	**0.001**	**0.01**	***F* = 5.71***	**2,1941**
Female	3.20*	1.01					
Male	3.42*	1.07					
Not listed/non-binary	3.34	1.03					
Age group			**$\eta_p^2 = 0.11$**	**0.08**	**0.13**	***F* = 74.28**	**3,1889**
<25 years	3.09	1.00					
25–35	3.20	1.03					
36–45	3.21	1.01					
46–55	3.26	1.03					
56–65	3.36	1.03					
>65 years	3.46	1.05					
Education stage			**$\eta_p^2 = 0.004$**	**0.0**	**0.008**	***F* = 1.73***	**5,1907**
K-primary[bcd]	2.87*	0.99					
Secondary[acd]	3.04*	0.96					
Tertiary[ab]	3.58*	0.96					
Other[ab]	3.80*	1.02					
Experience in teaching the subject			**$\eta_p^2 = 0.008$**	**0.002**	**0.01**	***F* = 3.95**	**4,1938**
≤5 years	3.15	1.01					
6–15 years	3.29	1.02					
16–25 years	3.22	1.01					
26–35 years	3.32	1.11					
>35 years	3.60	00.97					
Perceived relative effectiveness of remote teaching			**$\eta_p^2 = 0.20$**	**0.018**	**0.23**	***F* = 249.63***	**2,1941**
Less efficient	2.88*	0.89					
Equally efficient[e]	3.85*	0.90					
More efficient[e]	3.83*	1.07					
Appraisal of relative situational impact			**$\eta_p^2 = 0.01$**	**0.001**	**0.012**	***F* = 4.28**	**3,1940**
Students affected more than teachers	3.15	0.98					
Teachers and students affected equally	3.25	1.04					
Teachers affected more than students	3.41	0.99					
Not reported	3.42	0.98					
Mode of remote instruction			***d* = 0.64**	**0.55**	**0.74**	***t* = 13.75***	**1,942**
Synchronous	3.48*	1.00					
Asynchronous	2.85*	0.95					
Prior experience with remote teaching			***d* = 0.27**	**0.18**	**0.36**	***t* = 5.78***	**1,942**
Lack of experience	3.17*	1.02					
Prior experience	3.50*	1.02					

Superscripts indicate significant pairwise differences based on Tukey's post-hoc test ($p < 0.05$) [for education stages: a—K-primary, b—secondary, c—tertiary d—other; for efficiency: e—less efficient]. The bold values always refer to the influence on perceived student coping of each respective superordinate category.

estimated that their students were coping better and had fewer difficulties (M = 3.50, SD = 1.02), compared with teachers who had no prior experience with conducting online courses (M = 3.17, SD = 1.02).

Interestingly, differences in perception of student coping with remote teaching were unrelated to teachers' age, length of experience in teaching the subject, or appraisal of the relative situational impact on teachers and students.

Table 3 indicates the results of correlation analyses showing further relationships between indicators of teachers' professional and personal adaptation to ERT and perceived student coping with online learning, providing the answer to the third research question (RQ3). The way teachers perceive how their students cope with online courses is significantly and negatively correlated with teachers' evaluation uncertainty ($r = -0.57$) and instructional adjustment ($r = -0.45$). Moreover, the more effective the perception of remote teaching, the more the teachers felt students were coping with it ($\rho = 0.44$). Perception of student coping was also related to the education level handled, with more positive perceptions at higher education levels ($\rho = 0.32$). It also

TABLE 3 | Pearson's r[1] and Spearman's ρ[2] correlation coefficients between indicators of teachers' professional adaptation to ERT and perceived student coping with online learning.

	Perceived student coping	R^2	95%CI	
Evaluation uncertainty[1]	−0.57*	0.33	0.29	0.36
Instructional adjustment[1]	−0.45*	0.20	0.16	0.24
Perceived remote teaching effectiveness[2]	0.44*	0.17	0.13	0.21
Education level handled[2]	0.32*	0.10	0.06	0.14
Activity evaluation[1]	0.30*	0.09	0.05	0.13
Initial confidence in ability to teach remotely[1]	0.29*	0.08	−0.01	0.07
Overly demanding expectations[1]	0.21*	0.05	0.01	0.09
Supportive teaching[1]	0.14*	0.02	−0.02	0.06
Reassuring attitude[1]	−0.12*	0.02	−0.02	0.06
Sense of competence[1]	0.10*	0.01	−0.03	0.05
Appraisal of relative situational impact	0.03	0.00	−0.04	0.04

*Significant at $p < 0.05$.

correlated with teachers' ease of evaluating their students' activity ($r = 0.30$). Finally, there is a trend suggesting that teachers who from the very outset had felt confident teaching remotely found that their students experienced fewer difficulties ($r = 0.29$).

To reveal which of the indicators of teachers' professional adaptation to emergency remote instruction predict their perception of student coping with online classes (RQ4) and to find out the relative contribution of the respective predictors and the extent to which each of them determines teachers' perception of student coping (RQ5), we used ANCOVA to build a stepwise regression model with the forward selection procedure. It was preceded by a simple linear regression to additionally obtain a more general insight into how all the investigated indicators of teachers' professional and personal adaptation to ERT predict teachers' perception of student coping with online classes.

Table 4 illustrates the extent to which indicators of teachers' professional and personal adaptation to ERT predict their perception of student coping with online classes. The entire regression model is significant [$F_{(18,\ 1874)} = 108.70$, $p < 0.001$] and predicts ∼51% of variance in teacher perception of student coping with remote learning.

To more deeply probe the relative role of the indicators, we built a multiple regression model based on forward selection using an ANCOVA design. The results are presented in **Table 5**. The teachers' perception of how students cope with remote learning depends most on teachers' evaluation uncertainty ($\beta = -0.33$, $t = 17.19$, $p < 0.001$) and instructional adjustment ($\beta = -0.17$, $t = -8.96$, $p < 0.001$). It is also predicted by the extent to which teachers feel able to evaluate students' activity ($\beta = 0.14$, $t = 7.80$, $p < 0.001$), followed by the mode of remote instruction (synchronous vs asynchronous; $\beta = -0.10$, $t = -5.72$, $p < 0.001$). The subsequent most consequential predictors turn out to be perception of the effectiveness of remote teaching (respectively

TABLE 4 | The regression results of the effects of indicators of teacher professional and personal adaptation to remote teaching on the perception of student coping with online learning.

Dependent variable	R^2	Adj. R^2	F	df1	df2	95%CI	
Perceived student coping	0.51	0.51	108.70	18	1,874	0.48	0.53

less efficient than face-to-face instruction: $\beta = -0.17$, $t = -9.45$, $p < 0.001$ and equally efficient: $\beta = 0.07$, $t = 3.90$, $p < 0.001$), the education level handled (K-primary: $\beta = -0.07$, $t = -4.23$, $p < 0.001$ and tertiary: $\beta = 0.10$, $t = 5.65$, $p < 0.001$), immediately followed by teachers' appraisal of the relative impact of the pandemic situation on teachers and students (students affected more than teachers: $\beta = -0.04$, $t = -2.38$, $p < 0.001$ and both groups equally impacted by the pandemic context: $\beta = 0.04$, $t = 2.46$, $p < 0.001$). The subsequent predictors are supportive teaching ($\beta = 0.11$, $t = 5.90$, $p < 0.001$) and overly demanding expectations ($\beta = 0.06$, $t = 3.57$, $p < 0.001$) followed by sense of competence ($\beta = -0.09$, $t = -4.36$, $p < 0.001$) and perceived initial confidence in the ability to teach remotely ($\beta = 0.09$, $t = 4.70$, $p < 0.001$). The last two moderator variables are a reassuring attitude toward the students ($\beta = -0.05$, $t = -2.60$, $p < 0.001$) and prior experience with remote teaching ($\beta = 0.04$, $t = 2.40$, $p < 0.001$). Interestingly, teachers' gender did not contribute to the regression model.

DISCUSSION

The analyses revealed a number of factors that influenced teachers' perception of how their students were coping with emergency remote learning. These spanned both different aspects of professional adjustment and sociodemographic variables.

The inability to verify whether the students have been completing their online assignments and tests independently has been a recurrent concern, both in teachers' discussion forums and in the literature (e.g., Gonzales, 2020; Jargon, 2020). Given lack of an easy and foolproof way of ensuring student integrity outside of commercial automated proctoring software, many instructors have opted for open-book-style assessment that can both be individualized and at least does not penalize honesty.

The importance of being able to formatively evaluate students' activity is a related aspect. On the one hand, capacity to track students' progress facilitates summative evaluation at the end of the road. The divide created by the computer or smartphone screen impairs dialogue and the ability to provide tailored, ample feedback (Iwai, 2020) as well as to become aware of individual students' emotional and/or academic difficulties (Zaccoletti et al., 2020, p. 9). On the other hand, the outcome emphasizes the importance of teacher–student interaction. This connection is reinforced by the finding concerning the importance of synchronous classes, mirroring the results in Jelińska and Paradowski (2021). Limiting face-to-face interactions may adversely affect students' emotional development, emotional intelligence, and interpersonal and other soft skills (Hurst et al., 2013; Kaur and Bhatt, 2020, p. 45).

TABLE 5 | General linear model with ANCOVA (forward selection stepwise regression) for variables predicting teachers' perception of student coping with remote learning.

Step	Independent variables	*b*	SE	*β*	*t*	R^2	η_p^2	95%CI		*F*
1	Evaluation uncertainty	−0.24	0.01	−0.33*	−17.19	0.30	0.14	0.11	0.16	295.61
2	Instructional adjustment	−0.15	0.02	−0.17*	−8.96	0.30	0.04	0.03	0.06	80.23
3	Activity evaluation	0.09	0.01	0.14*	7.80	0.21	0.03	0.02	0.05	60.88
4	Remote teaching mode (asynchronous)	−0.10	0.02	−0.10*	−5.72	0.14	0.02	0.01	0.03	32.73
5	Perceived remote teaching effectiveness						0.05	0.03	0.07	48.19
	Less efficient	−0.26	0.03	−0.17*	−9.45	0.23				
	Equally efficient	0.11	0.03	0.07*	3.90	0.06				
6	Education level handled						0.03	0.02	0.04	18.35
	K-primary	−0.15	0.03	−0.07*	−4.23	0.17				
	Tertiary	0.18	0.03	0.10 *	5.65	0.12				
7	Appraisal of relative situational impact						0.01	0.00	0.02	8.10
	Students more affected than teachers	−0.08	0.03	−0.04*	−2.38	0.20				
	Teachers and students affected equally	0.07	0.03	0.04*	2.46	0.18				
8	Supportive teaching	0.18	0.03	0.11*	5.90	0.31	0.02	0.01	0.03	34.76
9	Overly demanding expectations	0.04	0.01	0.06*	3.57	0.12	0.01	0.00	0.01	12.72
10	Sense of competence	−0.13	0.03	−0.09*	−4.36	0.36	0.01	0.00	0.0.02	19.01
11	Initial confidence in ability to teach remotely	0.06	0.01	0.09*	4.70	0.27	0.01	0.00	0.02	22.11
12	Reassuring attitude	−0.05	0.02	−0.05*	−2.60	0.20	0.00	0.00	0.01	6.74
13	Prior experience with distance teaching	0.05	0.02	0.04*	2.40	0.15	0.00	0.00	0.01	5.77
14	Gender	–	–	–	–		–			–

*b—unstandardized regression coefficient; SE—standard error; β—standardized regression coefficient. *Significant at $p < 0.001$.*

Teachers who felt their students were coping worse were at once more likely to have introduced major adjustments to their instruction. This is a logical connection, as such alterations and the reprioritization of curriculum goals (Reimers and Schleicher, 2020) are usually made in response to perceived problems.

Perceptions of student coping differed substantially depending on the education level handled. This finding is in line with observations by Hvas and Aller (2020) and Jelińska and Paradowski (2021). One possible explanation is that young learners are the most reliant on assistance, scaffolding, and support in their scholastic process (Paradowski, 2014, 2015), while parents and other guardians may not always be around during the pandemic—or be capable—to help out with technology, ensure that the children stay on task and submit their work in a timely manner, and help out in other ways necessary. Younger students are also more likely to be affected by contextual factors (Sameroff, 2010), are more vulnerable to the impact of traumatic experiences (Bartlett et al., 2020), and have been missing their other caregivers such as grandparents (Dalton et al., 2020), who play a major role in their lives (Salvador, 2008; Clemente-González, 2016). Older, less dependent students have better-developed self-regulation strategies and are therefore better able to adapt and take control over their learning (Herold, 2017; Zaccoletti et al., 2020, p. 9). Younger children are moreover less likely to have a computer/tablet/smartphone to access remote classes in real time; it is also much more difficult for them to have to spend long hours stationarily in front of the screen.

The findings also emphasized the importance of a supportive and reassuring attitude. Teacher support has been positively related to indicators of student behavioral engagement, including enhanced participation in school activities, heightened academic motivation, and depressed disruptive behaviors (Wang et al., 2013). Indeed, a humanistic approach and a pedagogy of compassion (Bozkurt and Sharma, 2020), while always crucial, gains particular importance in difficult times like these, when the psychological pressure of the lockdown, social distancing restrictions, and remote schooling pile on top of academic workload, homework (Commodari and La Rosa, 2020, p. 5), and online evaluations (Navarro-Mateu et al., 2020).

Finally, the results emphasize the significance of initial convictions. The importance of teachers' perception of the ease of use of technology in a high-school context had been underlined e.g. by Allen and Seaman (2013); in the context of the current pandemic, Lederman (2020) emphasized that a lot hangs on the initial implementation of ERT.

CONCLUSIONS

The relationship between the student and the teacher has been claimed to be a major driver of the motivation to learn (Szabó, 2019, p. 19). Just as students' *self*-perceptions about own ability and competence are significantly associated with academic performance (Colom, 2012; De la Fuente et al., 2019; Ahmadi, 2020), *teachers*' perception of how their learners are coping have a strong automotive influence on their teaching effectiveness and may result in a self-fulfilling prophecy. Given that the post-pandemic world may see the trend of traditional classes becoming more blended (Kim, 2020) and increasingly integrating ICT (Gannon, 2019), there have been recommendations of

teacher training to adjust to the new instructional format (Toquero, 2020). Awareness of the variables influencing teachers' perception of how the students are handling non-F2F instruction will be useful to both instructors themselves and program directors and may influence the content of helpful training and intervention programs. One such adjustment may be educators' heightened role as facilitators (remotely) guiding, monitoring, and motivating their students (Paradowski, 2015; Luthra and Mackenzie, 2020).

Given the short length of some of the scales, as well as the use of single-item indicators, further studies may be needed to verify the validity of the respective findings. Also, with the data analyzed in this contribution coming from a cross-sectional sample, one cannot confidently establish causal relationships. Complementary analyses from a longitudinal component of the survey will feature in future publications.

Another obvious limitation is the issue of respondent self-selection. Given that participation in this study was entirely voluntary and that not infrequently the questionnaire took upwards of 45 min to complete, the respondents were already motivated, could relate to the topic, and had the spare time and technology to comfortably fill it out. This means a limit on the representativeness and generalization potential of the data and resultant findings. Nonetheless, the robust effects of at least the most influential factors merit attention.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The survey protocol had been approved by University of Warsaw's Human Research Ethics Committee. The respondents were provided with information about the survey and participated voluntarily.

AUTHOR CONTRIBUTIONS

MBP conceived the study and the questionnaire, piloted, and administered the data collection, performed the literature review, participated in the creation of the questionnaire and the writing of the manuscript. MJ carried out the analyses and participated in the creation of the questionnaire and the writing of the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.648443/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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APPENDIX

Jelińska, M. and Paradowski, M. B. (2021). Teachers' perception of student coping with emergency remote instruction during the COVID-19 pandemic: the relative impact of educator demographics and professional adaptation and adjustment. *Front. Psychol.* 12:648443. doi: 10.3389/fpsyg.2021.648443

TABLE A1 | Instructional adjustment scale–means, standard deviations, and item-total score-corrected correlations of the items ($N = 1,944$, $\alpha = .70$, $\omega_h = 0.68$, $\lambda_6 = 0.59$, $\rho = .98$).

Items	M	SD	r_{tt}
I have had to modify my lesson plans for remote teaching.	4.97	1.40	0.49
I have eased the grading scheme.	4.41	1.47	0.43
During this epidemic, I have felt that I have to alter not just the medium and method, but also the content of my classes.	4.29	1.60	0.54
Scale	13.66	3.55	0.41

TABLE A2 | Evaluation uncertainty scale–means, standard deviations, and item-total score-corrected correlations of the items ($N = 1,944$, $\alpha = 0.73$, $\omega_h = 0.75$, $\lambda_6 = 0.68$, $\rho = 0.98$).

Items	M	SD	r_{tt}
I find it difficult to evaluate students' activity during online classes.	4.20	1.59	0.66
I am unable to verify whether the students are learning.	3.94	1.54	0.66
I am anxious that some students may be using the situation to cheat in their assignments/exams.	3.71	1.75	0.37
Scale	11.85	3.87	0.46

TABLE A3 | Perceived student coping scale – means, standard deviations, and item-total score-corrected correlations of the items ($N = 1,944$, $\alpha = 0.72$, $\omega_h = 0.74$, $\lambda_6 = 0.69$, $\rho = 0.94$).

Items	M	SD	r_{tt}
I feel that some of my students have been left behind/fallen through the cracks in the shift to remote teaching.	2.48	1.51	0.53
My students have not coped well with remote learning.	3.42	1.39	0.67
My students have responded positively to my remote teaching.	4.23	1.18	0.37
The students have trouble with concentration and staying focused during the online classes.	2.83	1.45	0.48
Scale	12.97	4.10	0.40

TABLE A4 | Supportive teaching scale–means, standard deviations, and item-total score-corrected correlations of the items ($N = 1,944$, $\alpha = 0.72$, $\omega_h = 0.71$, $\lambda_6 = 0.69$, $\rho = 0.73$).

Items	M	SD	r_{tt}
I can talk my students into learning.	4.69	1.01	0.38
I try to make sure everyone in a group feels included	5.07	0.86	0.53
I am good at helping people work well together.	4.84	0.92	0.53
I try to make my group members happy.	4.91	0.89	0.54
I trust my students.	4.67	0.95	0.39
Scale	24.18	3.16	0.34

TABLE A5 | Sense of competence scale–means, standard deviations, and item-total score-corrected correlations of the items ($N = 1{,}944$, $\alpha = 0.76$, $\omega_h = 0.76$, $\lambda_6 = 0.74$, $\rho = 0.67$).

Items	M	SD	r_{tt}
I get things done quickly.	4.42	1.15	0.48
I know how to get things done.	4.88	0.92	0.55
Even with difficult tasks, I am always confident.	4.18	1.13	0.51
I like to work on tasks that require a great deal of skill.	4.64	0.99	0.45
I am a confident user of new technologies.	4.44	1.24	0.37
I continually train to keep my teaching skills and knowledge up-to-date.	4.56	1.18	0.39
I can manage many things at the same time.	4.87	1.07	0.52
I am always prepared.	4.65	1.10	0.39
Scale	36.61	5.25	0.29

TABLE A6 | Results of exploratory factor analysis.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
My students have not coped well with remote learning.	0.26	−0.02	0.07	−0.31	0.79
I feel that some of my students have been left behind/fallen through the cracks in the shift to remote teaching. 0.23	0.01	0.03	−0.38	0.50	
The students have trouble with concentration and staying focused during the online classes. 0.31	0.01	−0.01	−0.35	0.45	
My students have responded positively to my remote teaching.	0.29	0.10	0.09	0.01	0.42
During this epidemic, I have felt that I have to alter not just the medium and method, but also the content of my classes. −0.02	0.03	0.08	0.69	−0.06	
I have had to modify my lesson plans for remote teaching.	−0.16	0.02	0.03	0.68	−0.13
I have eased the grading scheme.	−0.22	0.01	−0.02	0.49	−0.10
I am unable to verify whether the students are learning.	−0.78	−0.11	−0.04	0.22	−0.21
I find it difficult to evaluate students' activity during online classes.	−0.71	−0.14	0.01	0.26	−0.15
I am anxious that some students may be using the situation to cheat in their assignments/exams. −0.45	−0.02	−0.10	0.02	−0.09	
I try to make my group members happy.	0.02	0.15	0.72	0.00	0.00
I try to make sure everyone in a group feels included.	0.02	0.18	0.68	0.06	0.07
I am good at helping people work well together.	0.03	0.34	0.56	−0.02	0.03
I can talk my students into learning.	0.09	0.28	0.37	0.04	0.07
I trust my students.	0.16	0.24	0.35	0.01	0.10
I know how to get things done.	0.00	0.64	0.02	0.02	0.02
I get things done quickly.	0.02	0.60	0.15	0.10	0.00
I can manage many things at the same time.	−0.01	0.60	0.15	0.10	−0.01
Even with difficult tasks, I am always confident.	0.06	0.58	0.12	−0.07	0.01
I like to work on tasks that require a great deal of skill.	0.09	0.47	0.15	−0.05	0.04
I am always prepared.	−0.04	0.46	0.09	−0.04	0.01
I am a confident user of new technologies.	0.15	0.40	0.07	−0.05	0.03
I continually train to keep my teaching skills and knowledge up-to-date.	0.05	0.38	0.29	0.08	−0.03

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Stress, Coping, and Resilience Before and After COVID-19: A Predictive Model Based on Artificial Intelligence in the University Environment

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The COVID-19 global health emergency has greatly impacted the educational field. Faced with unprecedented stress situations, professors, students, and families have employed various coping and resilience strategies throughout the confinement period. High and persistent stress levels are associated with other pathologies; hence, their detection and prevention are needed. Consequently, this study aimed to design a predictive model of stress in the educational field based on artificial intelligence that included certain sociodemographic variables, coping strategies, and resilience capacity, and to study the relationship between them. The non-probabilistic snowball sampling method was used, involving 337 people (73% women) from the university education community in south-eastern Spain. The Perceived Stress Scale, Stress Management Questionnaire, and Brief Resilience Scale were administered. The Statistical Package for the Social Sciences (version 24) was used to design the architecture of artificial neural networks. The results found that stress levels could be predicted by the synaptic weights of coping strategies and timing of the epidemic (before and after the implementation of isolation measures), with a predictive capacity of over 80% found in the neural network model. Additionally, direct and significant associations were identified between the use of certain coping strategies, stress levels, and resilience. The conclusions of this research are essential for effective stress detection, and therefore, early intervention in the field of educational psychology, by discussing the influence of resilience or lack thereof on the prediction of stress levels. Identifying the variables that maintain a greater predictive power in stress levels is an effective strategy to design more adjusted prevention programs and to anticipate the needs of the community.

Keywords: artificial neural networks, coping strategies, COVID-19, educational psychology, evaluation, health emergency, resilience, stress

INTRODUCTION

Late 2019, the World Health Organization identified a highly contagious virus, the SARS-Cov-2, in the city of Wuhan, China, which caused the "coronavirus disease 2019" or "COVID-19" (Wu et al., 2020, pp. 217–220). Society, overall, suffered the psychological consequences of this global health emergency (Ho et al., 2020; Liu S. et al., 2020; Schiavi et al., 2020; Xiao et al., 2020; Yang et al., 2020). Thus, a study carried out in 194 Chinese cities found that 53.8% of the people interviewed demonstrated psychopathological symptoms, 28.8% had severe anxiety symptoms, and 8.1% reported high levels of stress (Wang et al., 2020). In fact, stress was found to be one of the main variables in studies regarding the psychological effects of confinement (Brooks et al., 2020). The stressors associated with COVID-19 were diverse and included frustration, inadequate information, fear of contagion, and the length of quarantine (Agius et al., 2020; Brooks et al., 2020; Khan et al., 2020).

Parallelly, the educational community is a group that has been affected greatly, in which very explicit circumstances have arisen. According to the classic theory of Lazarus and Folkman (1986), when the demands of the environment exceed the resources to cope with a situation perceived as threatening, stress arises. Undoubtedly, COVID-19 and the confinement situation represented a drastic change of scenery. In this sense, a change was observed in the university structure itself, impacting both teaching staff and students as well as their social and family environments (Ando, 2020). In addition to the common sources of stress noted, students, in particular, were exposed to other factors specific to the education system: alterations in teaching methods, modification of the examination environment (conducted online), technical difficulties experienced while using virtual platforms, decreased physical activity and sleeping hours, among others. Moreover, 32% reported higher levels of stress when utilizing digital tools to appear for their examinations (Elsalem et al., 2020). A study conducted on 8,004 French students found that they had high levels of stress, other psychological symptoms, and a deep concern about aftereffects of the pandemic such as post-traumatic stress disorder (Essadek and Rabeyron, 2020). In Germany, 39.6% of university students reported increased stress levels (Schlichtiger et al., 2020). In Saudi Arabia, the prevalence of severe or extreme stress in this group was 13.4 and 10.7%, respectively (Alkhamees and Aljohani, 2021). A survey of a representative sample of the Spanish population demonstrated that 45.7% had experienced an elevation in their feeling of unease; further, the main reasons for seeking psychological help were the presence of depressive symptomatology (56.2%), and primarily, stress and anxiety (75.7%) (Balluerka et al., 2020). Similarly, as the duration of confinement extended, so did anxiety (26.9%), depression (27.5%), and stress (26.5%) (Ozamiz-Etxebarria et al., 2020). Another study involving the Spanish population found 41% to be stressed (Rodríguez-Rey et al., 2020). However, high levels of stress have also been reported in college students in pre-confinement studies (Cavallo et al., 2016; Sarrionandia et al., 2018; Taremian et al., 2018). Thus, it was found that 84.4% of university students showed stress to some degree, being mild in 33.8%, moderate in 35.4%, severe in 13.2% and extremely severe in 2.8% (Asif et al., 2020). With respect to these data, there is a wide variability in the results as demonstrated by Fares et al. (2016) finding in college students a range that went from 20.9 to 90%. High levels of faculty stress also existed in pre-pandemic research (Meng and Wang, 2018). Therefore, it is not yet possible to relate high stress scores to the confinement situation univocally, as such scores may already be present in the population. These facts justify the need to investigate current stress levels and other associated variables and compare them with previous situations to the extent that the research design allows for such comparisons.

Coping strategies are often associated with the need to combat a perceived threatening situation (Martínez and Morales, 2020; Martínez et al., 2020). In order to cope with stress during confinement, seeking social support was found to be one of the most used strategies among university students (Lechner et al., 2020). Another one was reported to be avoidance, which greatly helped to mitigate and combat stress, though technology and video games in the case of students at that stage (Balhara et al., 2020). Furthermore, cultural factors mediated the use of these strategies; thus, a study conducted in Pakistan with 1,134 university apprentices concluded that religion was the most widely employed coping strategy during COVID-19, followed by acceptance, self-destruction, and other active coping techniques (Salman et al., 2020). In another research involving over 80 Spanish-speaking universities in 13 different countries, cognitive strategies were key to adapting to the new situation of isolation, including the ability to seek its positive aspects (Fernández-Cruz et al., 2020). Similarly, in pre-covid periods, statistically significant positive relationships had also been found between the engagement in avoidant behaviors -through technological means- and perceived stress (Oliva et al., 2018), as well as negative relationships between higher social support and lower stress levels in young university students (Erschens et al., 2018).

Resilience can be defined as a person's ability to face the challenges and difficulties of life in a positive and adaptive manner, as well as the capacity to recover from an adverse event (Cénat et al., 2020; Glass et al., 2020). During confinement, the relationship between resilience and stress was also analyzed, and it became clear that it was complex (Ando, 2020; Marchini et al., 2020). In this regard, Liu C. H. et al. (2020) found that resilience was associated with low levels of depression and anxiety, but not with post-traumatic stress disorder. In pre-covid periods, it was observed that the implementation of problem-solving focused behaviors had a reducing effect on stress levels according to a study conducted with 218 undergraduated university students (Keech et al., 2018).

Regarding socio-demographic variables, it was observed that gender played an important role in students' mental health during COVID-19, with women being more susceptible to stress (Schlichtiger et al., 2020). Additionally, Rodríguez-Rey et al. (2020) found gender differences in the psychological consequences of confinement; in particular, women, younger people, and those at health risks were found to have more

psychopathological symptoms (Rodríguez-Rey et al., 2020). However, these differences have been inconsistent with respect to the situations before and after the initiation of confinement. Such is the case with the study conducted on 1,135 Brazilian university students and teaching staff, where no significant gender differences were found regarding the stress and resilience levels in both stages. When comparing the groups (professors versus students), the first ones had decreased levels of perceived stress and increased levels of resilience as compared to students (Amaral-Prado et al., 2020). In Spain, Ozamiz-Etxebarria et al. (2020) also found no dissimilarities in stress and anxiety levels between men and women. Besides, the relationships that were maintained at home between parents and children during confinement affected the development of stress, with the role of mother, parent, or legal guardian being a key factor in the general deterioration of students' psychological health (Bussone et al., 2020).

In addition to this, artificial intelligence has been used to examine multiple variables that define the pandemic and to combat COVID-19 (Haghshenas et al., 2020; Pirouz et al., 2020). Predictive models have been postulated as effective tools to meet the psychological needs, although its use is more widespread to other very diverse fields such as economics, medicine and transportation (Wu and Feng, 2018). Models based on artificial neural networks have been shown to possess higher accuracy than parametric equations in predicting stress (Dabiri et al., 2017). One such model has been developed by Rodríguez-Hidalgo et al. (2020) to predict depression based on the levels of stress, anxiety, and fear of COVID-19. Similar to coping strategies, artificial neural networks (ANNs) have also proven to be highly effective in developing frameworks adjusted to reality with the capacity to predict variables present in the university community members. Since this is a relatively recent form of data processing, ANNs potentially require further development in the field of education, and there is a clear need for additional research on this subject (Martínez and Morales, 2020). In relation to the theoretical model and in parallel to what has been explained thus far, educational psychology, as a branch of knowledge that is concerned with the variables affecting the teaching and learning processes of individuals, is ideal for facing new challenges, shedding light on the topic, favoring innovation, and analyzing the phenomenon under investigation using a scientific method (de la Fuente et al., 2018a). From the European Higher Education Area, the importance of the development of systemic competences, such as intrapersonal and interpersonal ones, has been indicated, among which those related to the resilience capacity, coping with stress, and frustration tolerance can be found (Amor and Serrano, 2018). More specifically, according to the EuroPsy model based on competences, a series of specific capabilities, such as using effective coping strategies in stress generating situations, empathy, emotional management, or handling difficult feelings that cause discomfort among others, have been identified and need to be developed from the perspective of psychology as well as other professions (Sanz, 2018; Stemmler and Spinath, 2019).

Therefore, as has been explained, the university is an environment in which people coexist and, due to various circumstances, they present high levels of stress (Amaral-Prado et al., 2020). These people implement a series of coping strategies to manage stress (Martínez and Morales, 2020). The questions that emerge are diverse: Does stress really exist in people related to the university? What is the relationship between the stress they present and the use of one type of coping strategy or another? Is it possible to predict stress based on a series of parameters by means of a statistical model related to artificial intelligence as is being done in other fields of study? Knowing which are the most effective strategies associated with the absence of stress would allow designing more adjusted intervention programs at later stages, specifically focused on the development of those behaviors that predict a better adjustment. This is in line with the level of analysis that is the responsibility of educational psychology (de la Fuente et al., 2021). Having said that, this research aimed to examine the relationship between certain variables related to stress and to design an ANN predicting the presence or absence of stress among people related to the university educational field (faculty, students, and families), based on artificial intelligence. This general objective was divided into three specific ones. (1) to analyze the variable of stress and its relationship with coping strategies, and resilience; (2) to examine the differences between the pre-covid and post-covid period on stress, resilience, and coping strategies; and (3) to design and select the artificial neural network that has the best predictive capability. These objectives are based on the fact that relationships between stress and the use of certain dysfunctional coping strategies have been found in the scientific literature (Oliva et al., 2018; Martínez and Morales, 2020) as well as between stress and low resilience before (Keech et al., 2018) and after COVID-19 (Liu C. H. et al., 2020). The complexity of the variables involved in predicting human behavior in confinement justifies the use of artificial intelligence techniques to shed light on the issue (Zawacki-Richter et al., 2019). Following these ideas, the hypotheses were: (H1) Stress level is anticipated to have a direct and positive link with the use of dysfunctional coping strategies; (H2) stress level is expected to have an indirect relationship with resilience; (H3) higher levels of stress are expected to be found after the confinement situation in relation to moments prior to the state of alarm decree; and (H4) the coping strategies are closely related to stress levels so that those productive strategies (such as problem-solving and positive reappraisal) will be related to the absence of stress or low levels and those negative strategies (e.g., avoidance and negative self-focus) will be related to the presence of stress or higher levels.

MATERIALS AND METHODS

Procedure

This study employed a quantitative approach, and a transversal, *ex post facto* design. A non-probabilistic snowball sampling method was conducted to contact the potential participants by sending across a description of the study's aim and a link to an online survey in periodic waves, as obtained by Ozamiz-Etxebarria et al. (2020). The research was carried out from May 2019 to May 2020; thus, comparing the two independent groups (those who participated before versus after the declaration

of the state of alert) was possible. Therefore, this study is a continuation of research that preceded the discovery of COVID-19 and continued after its emergence. In Spain, lockdown was implemented on March 15, 2020, following the publication of the Royal Decree 463/2020 of March 14 in the Official State Bulletin that declared the state of emergency for the management of the health crisis situation caused by COVID-19 (BOE, 2020). Consequently, it is possible to differentiate between two situations: (1) a pre-covid situation or *Timing*=0 understood as the period prior to the confinement in Spain and which spanned from the beginning of the study in May 2019 to the publication of the state of alarm decree and the beginning of the confinement –March 13, 2020-; (2) and a post-covid situation or *Timing*=1 which started in this research on March 14, 2020 and ended in May 2020. With regard to the ethical aspects of the research, the guidelines of the Declaration of Helsinki and an ethics committee were taken into consideration during the entire study. Informed consent was required. Participation in the study was voluntary, anonymous, and confidential.

Participants

The research comprised 337 participants (73% women, n=243) from the university education in south-eastern Spain, belonging to Granada (32%, $n_{Granada}$=108), or the Region of Murcia (68%, n_{Murcia}=229), Initially, 343 entries were obtained; however, 7 (2.04%) were excluded because those individuals did not belong to the "university education community." This last term has been extracted from the normative sphere when developing certain educational laws in which any person (educational agent) who is directly or indirectly related to an educational center or institution, including teachers, students and their families, is considered a member of the educational community. Therefore, this concept does not assume representativeness of the population *per se*, merely membership. With regard to the educational role, 60.2% (n=203, $n_{Granada}$=68, n_{Murcia} = 135) were undergraduate or postgraduate students, 28.8% (n=97, $n_{Granada}$=26, n_{Murcia}=71) were professors (including the positions of associate professor, doctoral assistant or full professor), and 11% (n=37, $n_{Granada}$=14, n_{Murcia}=23) were family members (mother, father, or legal guardian). Regarding the branch of knowledge of the students (n=203), 17.2% (n=35, $n_{Granada}$=20, n_{Murcia}=15) belonged to Art and Humanities, 15.3% (n=31, $n_{Granada}$=11, n_{Murcia}=20) studied Science, 29% (n=59, $n_{Granada}$=7, n_{Murcia}=52) in Health Sciences, 31% (n=63, $n_{Granada}$=27, n_{Murcia}=36) in Social and Legal Sciences, 6.4% (n=13, $n_{Granada}$=2, n_{Murcia}=11) in Engineering and Architecture and the remaining residual were missing cases. The participants' age ranged from 18 to 67 years (M_{age}=33.11, SD=12.83). With regard to marital status, 62.3% (n=210) were single, 33.5% (n=113) were married or in a common-law relationship, 3.9% (n=13) were divorced or separated, and 0.3% (n=1) were widowed. In relation to the timing of administration of the measure, 45.7% (Timing=0, n=154, $n_{Granada}$=34, n_{Murcia}=120) partook in the research prior to the confinement period, while 54.3% (Timing=1, n=183, $n_{Granada}$=74, n_{Murcia}=109) participated after the lockdown was decreed.

Instruments

The following instruments were administered:

An ad hoc sociodemographic questionnaire. Information related to the time of administration (differentiating between before and after the initiation of quarantine), sex (male or female), age (in years), marital status (married or with a partner, single, widowed, or divorced), educational role (family, student, or professor including related professionals), and place (Granada or Region of Murcia) were collected in order to delimit the conditions of the study. Six items were used for this research and multiple choice questions were used.

Perceived Stress Scale (PSS) by Cohen et al. (1983). In particular, the Spanish adaptation of this measure was administered (Remor, 2006). It comprises 14 items that are marked between 0 "Never" to 5 "Very often." Items 1, 2, 3, 8, 11, 12, and 14 are direct, while the others are indirect. The scores are summated, with higher scores indicative of greater levels of perceived stress and vice versa. Example of a direct item: (Item 2) "In the last month, how often have you felt unable to control the important things in your life?". Example of an indirect item: (item 9) "In the last month, how often have you been able to control the difficulties in your life?". In the Spanish version, a Cronbach's alpha of 0.81 was obtained (Remor, 2006), and in a recent research it was found to be 0.86 (Martínez and Morales, 2020). In this study, it was 0.857. Therefore, in the present research the PSS was selected because of its recognized reliability and validity (Remor, 2006) as well as its wide use nationally, internationally and in multiple fields (Díaz-Corchuelo et al., 2015; Kourmousi et al., 2015; Chowdhury et al., 2017). Besides, the perceived stress variable was used as a variable dependent on the ANN and was recoded into 2 levels (absence versus presence of stress) using the 50th percentile as the cut-off point (P_{50}=26.00). Previous studies have shown the usefulness of using the 50th percentile to work with a bipolar variable when designing the artificial neural network architecture (Navarro, 1998; Martínez and Morales, 2020).

Stress Coping Questionnaire (CAE in Spanish version) by Sandín and Chorot (2003). This 42-item instrument is rated on a 5-point Likert scale, ranging from 0 "Never" to 4 "Almost always." The items are grouped into 7 dimensions, each of which is a coping strategy, and the scores are obtained by summating the items that form the strategy. Their internal consistencies, measured using Cronbach's alpha ranged from 0.64 to 0.85 (Sandín and Chorot, 2003). **Table 1** shows the configuration of each dimension, the Cronbach's alpha values obtained in this study, and an example of an item.

Brief Resilient Coping Scale (BRCS) by Sinclair and Wallston (2004). The Spanish version of this scale was utilized (Moret-Tatay et al., 2015). It comprises 4 items responded on a 5-point Likert scale, ranging from 1 "It doesn't describe me at all" to 5 "It describes me very well." The higher the score, the greater the resilience. It is also possible to distinguish 3 levels by using the following intervals (Sinclair and Wallston, 2004): 4 to 13, 14 to 16, and 17 to 20 points, indicating low, medium, and

TABLE 1 | Coping strategies.

Coping strategies		Items	Cronbach's alpha	Example of item
Focus on the solution of the problem	FSP	1, 8, 15, 22, 29 and 36	0.852	"To follow some concrete steps" (Item 8)
Negative self-focus	NSF	2, 9, 16, 23, 30 and 37	0.730	"Not to do anything since things are often bad" (Item 9)
Positive re-evaluation	PRE	3, 10, 17, 24, 31 and 38	0.783	"Getting something positive out of the situation" (Item 10)
Open emotional expression	OEE	4, 11, 18, 25, 32 and 39	0.669	"Insulting other people" (Item 11)
Avoidance	AVD	5, 12, 19, 26, 33 and 40	0.741	"Turning over a new leaf at work or in other activities" (Item 12)
Seeking social support	SSS	6, 13, 20, 27, 34 and 41	0.935	"To ask advice from relatives or friends" (Item 13)
Religion	RLG	7, 14, 21, 28, 35 and 42	0.922	"Asking for spiritual help" (Item 14)

Source: Sandín and Chorot (2003).

high resilience, respectively. Example of an item is "Whatever happens to me, I think I can control my reactions" (Item 2). In previous studies, the internal consistencies of the Spanish version were found to be 0.78 (Martínez and Morales, 2020) and 0.87 (Caycho-Rodríguez et al., 2018). In the present study, a Cronbach's alpha of 0.778 was obtained.

Data Analysis

A descriptive and inferential analysis of the data was carried out. For the former, frequencies, percentages, and main dispersion indexes were calculated. For the latter, parametric tests (Pearson's correlation and Student *t*-test) were used, assuming that a sample larger than 30 allows for the assumption of normality to be met, according to the central limit theorem (Kwak and Kim, 2017). In the analyses of this study, the *p*-value considered was 0.001. Additionally, an ANN of multilayer perception was designed, based on a logistic regression analysis through which the network learned categorizing the cases properly by itself. The architecture of the neural network was planned using 3 phases: training, testing, and backup. The allocation of participants to each of the phases was 60, 30, and 10%, respectively (although the network, seeking the best fit, autonomously assigned 57.7, 34.8, and 7.4%, respectively). Even though the inclusion of the last phase was optional, it was recommended to avoid overtraining the network and to achieve an improved adjustment. Initially, a random seed was generated following the IBM guidelines (International Business Machines, 2011). This was performed by using the random number generator and setting a fixed value as the starting point (9191972) that facilitated the replicability of the study. The evaluation of the artificial neural network was performed through the sensibility, gain and lift indices. These indices are part of the ROC curves (receiver operating characteristic curve) which are based on the signal detection theory and allow measuring the accuracy of the measurement by analyzing the AUC (area under the curve) (Swets, 1988; Hand and Till, 2001). In more detail, perfect discrimination would correspond to an AUC=1 while non-discrimination would be related to an AUC=0.5 which is equivalent to hit by chance; the higher the area under the curve, the better the discrimination of true positives (Janssens and Martens, 2020). So, in spite of working with a modest sample, the use of Artificial Neural Networks allows an adequate treatment of the data and the generation of predictive models. The SPSS version 24 statistical program was employed (IBM Corp, 2016) for data analyses.

RESULTS

Stress, Coping Strategies, and Resilience

In a preliminary analysis using Pearson's correlation to examine the relationship between the variables initially proposed to develop the network, it was found that some of the highest correlations were obtained between resilience and problem-solving focus (r_p=0.530, $p < 0.001$) and between resilience and positive reappraisal ($r_p = 0.530$, $p < 0.001$). According to correlational analysis, higher scores on perceived stress were associated with: younger age ($r_p = -0.151$, $p < 0.001$); lower resilience ($r_p = -0.387$, $p < 0.001$); lower use of the coping strategies of problem-focusing ($r_p = -0.355$, $p < 0.001$), and positive reappraisal ($r_p = -0.260$, $p < 0.001$); and greater use of the coping strategies of negative self-focus (r_p=0.478, $p < 0.001$), open emotional expression ($r_p = 0.231$, $p < 0.001$), and avoidance ($r_p = 0.172$, $p < 0.001$).

Table 2 shows the descriptive statistics, skewness, and kurtosis of the continuous variables (including the independent and

TABLE 2 | Descriptive analysis of continuous variables (*N* = 337).

	Min.	Max.	*M*	*SD*	Skewness		Kurtosis	
					Statistic	Std. error	Statistic	Std. error
DV								
Stress (total)	5	52	25.63	8.929	0.261	0.133	0.041	0.265
Stress (−1, 1)	−1	1	−0.6	1.000	0.125	0.133	−1.996	0.265
IV								
FSP	4	24	16.22	4.676	−0.282	0.133	−0.711	0.265
NSF	0	21	7.71	4.015	0.649	0.133	0.350	0.265
PRE	4	24	15.85	4.179	−0.366	0.133	−0.414	0.265
OEE	0	21	8.01	3.739	0.566	0.133	0.457	0.265
AVD	0	24	12.23	4.615	0.111	0.133	−0.098	0.265
SSS	0	24	14.28	6.276	−0.197	0.133	−0.885	0.265
RLG	0	24	3.89	5.584	1.620	0.133	2.006	0.265
Resilience	4	20	15.05	3.201	−0.583	0.133	0.120	0.265
Age	18	67	33.11	12.829	0.731	0.133	−0.610	0.265

DV, dependent variable; IV, independent variable; Min., minimum; Max., maximum; M, mean; SD, standard deviation; FSP, focusing on the solution of the problem; NSF, negative self-focus; PRE, positive re-evaluation; OEE, open emotional expression; AVD, avoidance; SSS, search for social support; RLG, religion. Source: own elaboration.

dependent variables) that will later be considered to form the artificial network.

Table 3 shows the scores of the continuous variables analyzed in the presence and absence of stress. The mean age of people presenting stress (M=30.92, SD=12.151) was significantly lower (t=2.981, p=0.003) than those not presenting (M=35.06, SD=13.132). Differences between means were also found for resilience (t=6.184, p=0.000) such that those placed in the no stress category obtained higher means in resilience (M=16.02, SD=2.646). Various coping strategies were associated with the presence of stress such as avoidance (t=−2.502, p=0.13) to cite one example.

Regarding the examination of differences between the means based on gender, women showed a higher average in stress (M=25.94, SD=9.071) than men (M=24.78, SD=8.523); however, this difference was not significant (t=−1.062, p=0.289).

Pre-covid and Post-covid Period

In relation to the analysis of the stress levels according to the moment or timing, it was observed that 46.9% of the total participants perceived stress (n=158), with 23.1% (n = 78) in the pre-confinement situation and 23.7% (n = 80) after it. No statistically significant differences were found in the means (t=1.560, SD=0.120) between the previous (M=26.45, SD=9.353) and subsequent months (M=24.93, SD=8.519).

In another vein, **Table 4** shows the existence of significant differences in the use of open emotional expression strategies (t=2.448, p=0015) between the pre and post-COVID period with a considerable decrease. The same occurred with the social support seeking strategy (t=2.554, p=0.011). However, the religion variable score increased (t=−4.695, p=0.000).

TABLE 3 | Student *t*-test for stress.

	Stress	N	M	SD	t	Sig.
Age	Absence	178	35.06	13.132	2.981	0.003
	Presence	158	30.92	12.151		
FSP	Absence	179	17.60	4.270	6.085	0.000
	Presence	158	14.65	4.633		
NSF	Absence	179	6.20	3.389	−7.953	0.000
	Presence	158	9.42	3.988		
PRE	Absence	179	16.73	3.836	4.217	0.000
	Presence	158	14.85	4.337		
OEE	Absence	179	7.40	3.700	−3.198	0.002
	Presence	158	8.69	3.676		
AVD	Absence	179	11.65	4.691	−2.502	0.013
	Presence	158	12.90	4.450		
SSS	Absence	179	14.42	5.854	0.423	0.673
	Presence	158	14.13	6.738		
RLG	Absence	179	3.97	5.520	0.256	0.798
	Presence	158	3.81	5.672		
Resilience	Absence	179	16.02	2.646	6.184	0.000
	Presence	158	13.94	3.418		

M, mean; SD, standard deviation; FSP, focusing on the solution of the problem; NSF, negative self-focus; PRE, positive re-evaluation; OEE, open emotional expression; AVD, avoidance; SSS, search for social support; RLG, religion. Source: own elaboration.

TABLE 4 | Scores before (Timing=0) and after COVID-19 (Timing=1).

	Timing	N	M	SD	t	p
Stress	Before	154	26.45	9.353	1.560	0.120
	After	83	24.93	8.519		
FSP	Before	154	15.47	4.712	−2.735	0.007
	After	83	16.85	4.563		
NSF	Before	154	8.44	3.689	3.111	0.002
	After	83	7.09	4.181		
PRE	Before	154	15.84	4.102	−0.056	0.955
	After	83	15.86	4.254		
OEE	Before	154	8.55	3.459	2.448	0.015
	After	83	7.55	3.912		
AVD	Before	154	12.93	4.468	2.554	0.011
	After	83	11.65	4.668		
SSS	Before	154	14.50	6.435	0.585	0.559
	After	83	14.10	6.150		
RLG	Before	154	2.38	4.538	−4.695	0.000
	After	83	5.16	6.058		
RES	Before	154	14.68	3.311	−1.931	0.054
	After	83	15.36	3.081		

M, mean; SD, standard deviation; t, t de student; p, significance; FSP, focusing on the solution of the problem; NSF, negative self-focus; PRE, positive re-evaluation; OEE, open emotional expression; AVD, avoidance; SSS, search for social support; RLG, religion; RES, resilience. Source: own elaboration.

Design, Architecture, and Evaluation of the Artificial Neural Network

In relation to this point, it is necessary to differentiate between the design of an artificial neural network that encompasses the main variables of the study (ANN-1) and the neural network with the highest predictive capacity found (ANN-2) although the latter case entails eliminating variables from the model.

Artificial Neural Network Composed of the Main Variables (ANN-1)

Initially, a network (ANN-1) was programmed to contemplate the main sociodemographic variables, resilience, coping strategies, and stress. These variables and the normalized importance are shown in **Table 5**.

Although the network was programmed to select 60, 30, and 10% of the participants to generate the training, testing and holdout phases, the network has the capacity to adjust these values. As a result, the distribution of participants in the three phases was 59.2, 28.9, and 11.9%, respectively. During the training phase the cross entropy error was 120.217 and the percent incorrect predictions was 30.2%. The stopping rule used was after one consecutive step with no decrease in error. In the testing phase the cross entropy error was 58.251 and the percent incorrect predictions was 29.9%. Finally, in the holdout phase, the percent incorrect prediction was 12% (**Table 6**). As can be concluded, the percentage of error in the predictions was decreasing from the training phase to the final or holdout phase,

TABLE 5 | Independent variable importance of ANN-1.

	Importance	Normalized importance
Sex	0.004	1.7%
Marital status	0.015	7.2%
Educational role	0.011	5.4%
Place of residence	0.008	3.6%
Focusing on the solution of the problem	0.211	100%
Negative self-focus	0.183	86.9%
Positive re-evaluation	0.038	18.2%
Open emotional expression	0.187	88.8%
Avoidance	0.083	39.4%
Search for social support	0.091	43.2%
Religion	0.008	4.0%
Resilience	0.126	59.5%
Age	0.034	15.9%

Source: own elaboration.

TABLE 6 | ANN-2 predictive capacity.

Sample	Observed	Predicted		
		Absence	Presence	Percent correct
Training	Absence	85	15	85%
	Presence	43	51	54.3%
	Overall percent	66%	34%	70.1%
Testing	Absence	57	7	89.1%
	Presence	21	32	60.4%
	Overall percent	66.7%	33.3%	76.1%
Holdout	Absence	13	1	92.9%
	Presence	2	9	81.8%
	Overall percent	60%	40%	88.0%

Dependent variable: stress (absence versus presence). Source: own elaboration.

which represents an improvement in the predictive capacity of the network and is a reflection of autonomous learning.

The network generated three layers. The input layer consisted of four factors (sex, marital status, educational role, and place of residence) and 9 covariates (focusing on the solution of the problem, negative self-focus, positive re-evaluation, open emotional expression, avoidance, search for social support, religion, resilience, and age). Covariates were not rescaled. The hidden layer consisted of seven neurons and the activation function was the hyperbolic tangent. In the output layer, the dependent variable "stress" is located, differentiating two levels (presence and absence). The activation function of this layer was softmax and the error function was the cross-entropy.

With respect to the predictive capacity of the resulting network, during the training phase the network was able to correctly classify 69.8% of the cases. In the testing phase, whose objective is to perfect the network by making the necessary adjustments to its selection algorithm, a hit rate of 70.1% was achieved. Finally, in the holdout phase, in which the network works with data that has never been presented to it, it achieved an 80% correct prediction rate. Therefore, the percentage of incorrect predictions was 20%. For the evaluation of the ANN-1, the ROC curves were analyzed. The area under the curve was 0.748 for the absence and presence of perceived stress, well above chance (0.5). **Figures 1–3** show the sensibility, gain, and lift values, respectively.

Neural Network With Greater Predictive Capacity (ANN-2)

With respect to the ANN-2 programming and architecture, the network, within its learning autonomy, assigned 57.7% (n=194)

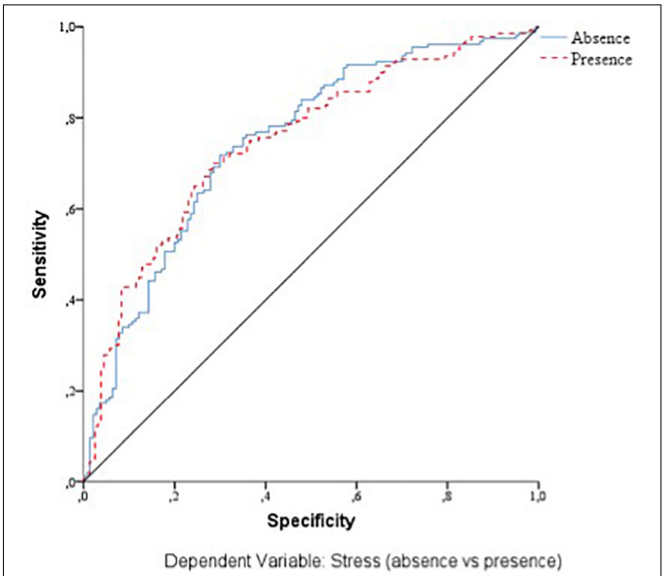

FIGURE 1 | Sensitivity of the dependent variable stress (ANN-1). Source: own elaboration.

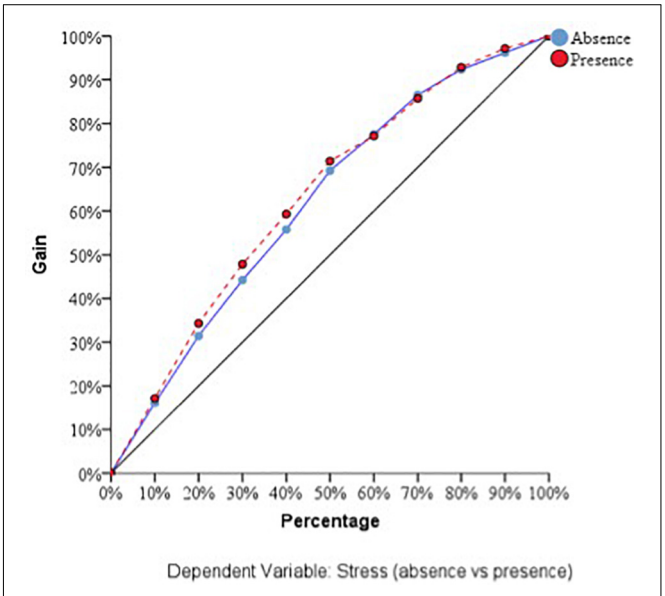

FIGURE 2 | Gain of the dependent variable stress (ANN-1). Source: own elaboration.

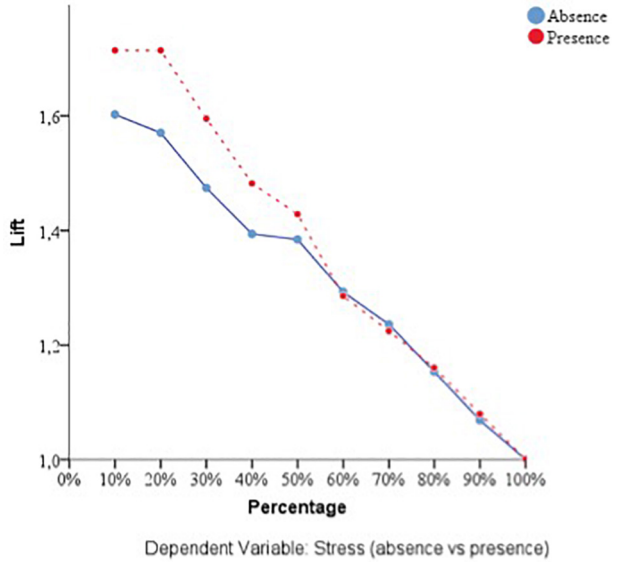

FIGURE 3 | Lift of the dependent variable stress (ANN-1). Source: own elaboration.

of the cases to the training phase, 34.8% (n=117) to the testing phase and 7.4% (n=25) were used for the holdout phase. The network excluded one case.

With respect to the evolution of the incorrect percentages of prediction of the dependent variable "Stress" (absence versus presence), in the training sample, the cross entropy error was 110.559 and the percent incorrect prediction was 29.9%. The stopping rule used was one consecutive step with no decrease in error. In the testing sample, the network managed to reduce the cross entropy error to 62.389 with a percent incorrect prediction of 23.9%. The network again reduced the percent incorrect predictions to 12% in the holdout sample (totally new cases) as it learned to classify information autonomously (**Table 6**).

The information in the network consisted of an input layer composed of 5 factors (gender, marital status, educational role, place of residence, and time of administration) and covariates (focusing on the solution of the problem, negative self-focus, positive re-evaluation, open emotional expression, search for social support, avoidance, and religion). Taking into consideration the levels of each variable, this layer comprised 19 units in total. No method was used to rescale the covariates. The second or the hidden layer was formed of 7 units that the computer program generated to process and modulate the flow of information. The program generated the number of hidden units necessary to optimize the predictive capability of the network in line with one of its basic characteristics, which is to learn autonomously. Its activation function was a hyperbolic tangent. The third or the last layer was the output one, composed of 2 units (absence and presence of stress). In this case, the activation function was softmax, and the activation error was calculated using the means of cross entropy. The graphic representation of the relationships that the variables maintained with each other across the 3 layers of ANN is shown in **Figure 4**.

The same configuration of the variables and programming of the network, however, using a different distribution of participants between the 3 phases produced substantial differences in the predictive capacity. Thus, using the traditional 70% training, 20% testing, and 10% holdout, an ANN was designed that predicted 72.6, 79.2, and 61.8% of the correct cases, respectively. However, by modifying the classification and allowing the ANN test phase to receive more sleep to optimize its algorithm, the final holdout phase was widely favorable, reaching levels above 88%, as presented in 7.

The importance and standardized significance understood as the contribution of independent variables to ANN are shown in **Table 7**. Coping strategies and resilience contributed more to the network than the sociodemographic variables.

With respect to the assessment of the ANN, its sensitivity is displayed in **Figure 5**. The area under the curve was 0.772 during both the absence and presence of stress. Sensitivity analysis allowed a graphical representation of the performance of the network based on the test and training phase. The area under the curve reflected the accuracy of such a network or, in other words, the predicted pseudo-probability of successfully locating a randomly extracted case. These values were above 0.5; thus, it has been graphically shown that the ANN was well above chance in its predictive ability. **Figures 4**, **5** show the evolution of the percentage of the ROC curves "gain" and "lift," respectively, for each of the 2 values that the dependent variable can take. **Figure 6** shows a graph of accumulated gains. The curve is steeper in the case of detecting the presence of stress up to 80% of the gain, at which point it is surpassed by the no-stress curve. Both are above the baseline. **Figure 4** depends on Type I error (cost of classifying a subject likely to be stressed as having no stress) and Type II error (cost of classifying a subject who will not perceive stress as a person likely to perceive stress). The closer the curve is to the upper left corner, the more accurate it is. It is possible to observe how the curve is well above the base line or diagonal so the model is accurate. **Figure 7** starts from the relationship between cumulative earnings and the baseline. It is derived from the previous figure. It serves to be able to represent the information in another way. The 10% increase for the category presence of stress is about 2.0 (20%), while for the category absence of stress it drops to 1.4–1.5 (14–15%). The trend is reversed at 80%.

DISCUSSION

The main objective of this research was to study the relationship between certain variables related to stress and to design an ANN predicting the presence or absence of stress. With respect to hypothesis H1, according to which we expected to find a positive relationship between stress levels and the use of non-proactive strategies, it is partially confirmed. The coping strategies considered, namely, functional and active (FSP and PRE), were associated with lower levels of stress and vice versa (NSF, OEE, and AVD). However, the expected association was not found in the case of search for social support (SSS); this result is partly in line with that of Rodríguez-Rey et al. (2020), who observed that those people who implemented more

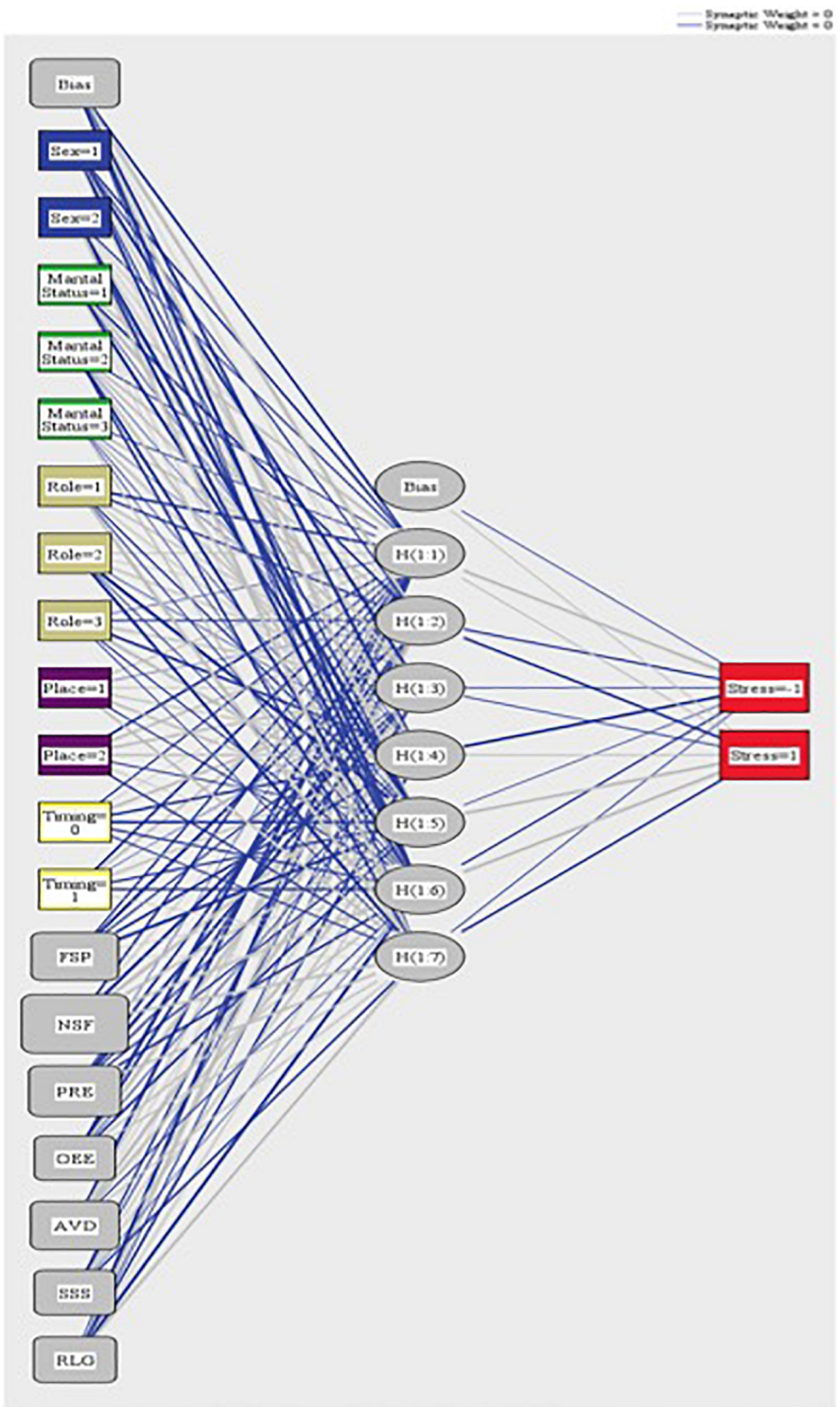

FIGURE 4 | ANN-2 representation of stress. Sex=1: male; Sex=2: female; MaritalStatus=1: married or common-law partner: MaritalStatus=2: divorced or separated; MaritalStatus=3: single; role=1: family; role=2: student; role=3: professor; place=1: University of Granada; Place=2: University of Murcia; timing=0: pre-covid; timing=1: post-covid; NSF, negative self-focus; PRE, positive re-evaluation; AVD, avoidance; FSP, focusing on the solution of the problem; RLG, religion; SSS, search for social support; OEE, open emotional expression. Source: own elaboration.

TABLE 7 | Importance of the independent variables included in the definitive artificial neural network model (ANN-2).

	Importance	Normalized importance
Sex	0.003	1.2%
Marital status	0.011	3.8%
Educational role	0.012	4.2%
Place of residence	0.007	2.3%
Timing (before or after confinement)	0.007	2.6%
Focusing on the solution of the problem	0.127	45.1%
Negative self-focus	0.282	100%
Positive re-evaluation	0.164	58.1%
Open emotional expression	0.078	27.6%
Avoidance	0.138	48.8%
Search for social support	0.080	28.6%
Religion	0.092	32.6%

Source: own elaboration.

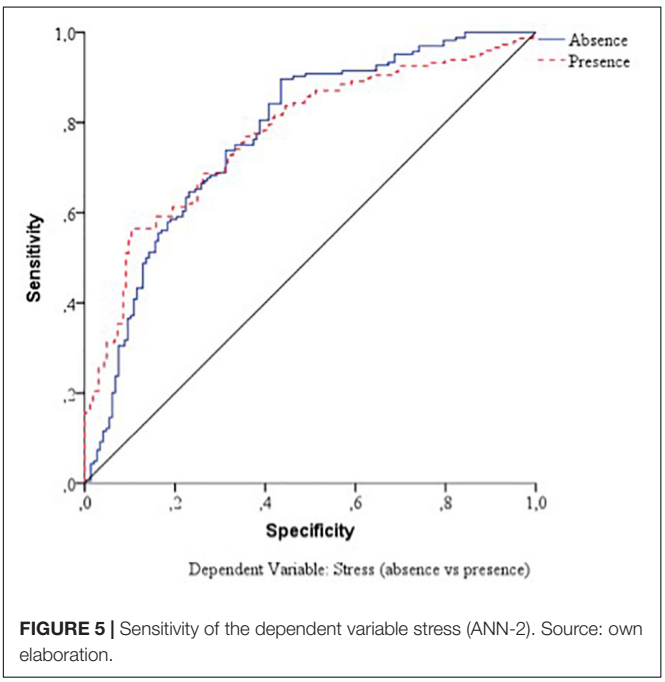

FIGURE 5 | Sensitivity of the dependent variable stress (ANN-2). Source: own elaboration.

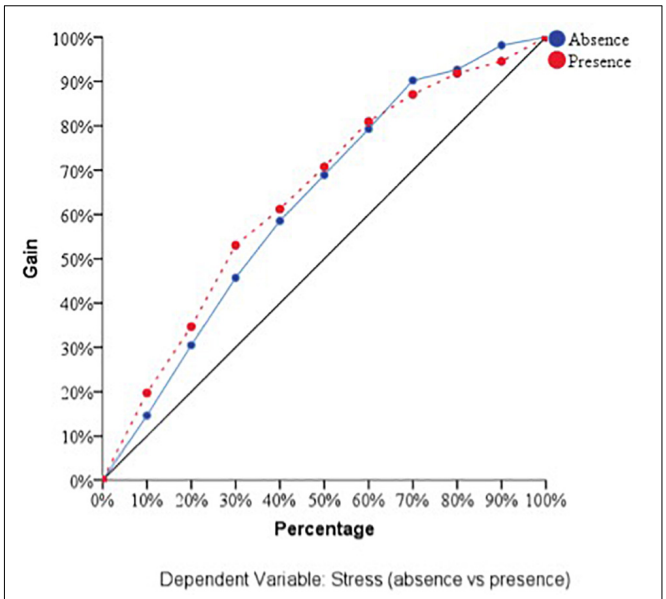

FIGURE 6 | Gain of the dependent variable stress (ANN-2). Source: own elaboration.

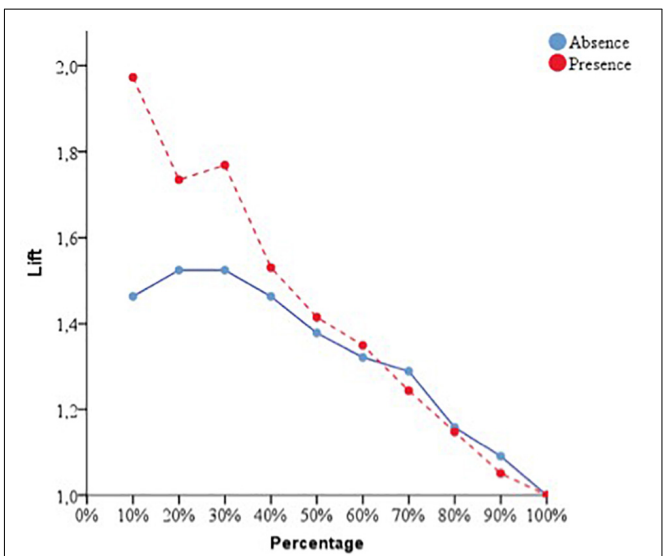

FIGURE 7 | Lift of the dependent variable stress (ANN-2). Source: own elaboration.

adaptive and active strategies presented a better psychological functioning. Moreover, Lechner et al. (2020) reported that association of the perception of social support with improved personal adjustment was estimated to be rarely present during high levels of stress.

With regard to H2, according to which stress levels were expected to have an indirect relationship with resilience, the hypothesis is again partially confirmed. However, it is not possible to fully confirm the initial hypothesis because, when designing the artificial neural network, the results differed from what was expected. The initial inferential analysis (preliminary study using Pearson's correlation and *t* de Student) demonstrated the existence of a certain relationship between previous resilience levels and stress levels. People with stress had a lower mean in resilience. Besides, resilience plays a main role in ANN-1. This is in line with the conclusions drawn from a comparative study prior to the confinement stage between the United States and Spain (Sarrionandia et al., 2018; Galante et al., 2021). However, despite these preliminary analysis and the results of the ANN-1, when searching for the best network, it was found that the ANN-2 increased the predictive capacity for stress when resilience was deleted. Specifically, in the process of obtaining the best model, it was observed that eliminating the "resilience" and "age" variables increased the predictive

capacity of the ANN above 80%. Therefore, the relationship between resilience and stress remains unclear, contrary to results of the previous studies (Ando, 2020; Marchini et al., 2020). It is possible that rather than having a direct association with stress, these variables played a mediating role. Similarly, Liu C. H. et al. (2020) did not find a relationship between resilience and post-traumatic stress disorder; however, one was found in the case of anxiety. The second model (ANN-2) obtained a predictive capacity of 88%, without forgetting the fact that there was a 12% chance of making a mistake in the classification. That is 8% more success compared to ANN-1 (which includes resilience). Anyway, the success rates of ANN-1 and ANN-2 were much higher than the possibility of getting it right by chance, so both artificial neural networks can be considered valid. In the present study, it is possible that the fact that there is a high relationship between resilience and the coping strategies of "problem-focusing" and "positive reappraisal" may have influenced the predictive capacity of the network. It appears that resilience shares a high percentage of variance with them so that by simplifying the model by subtracting variables, the influence of resilience was still present through FSP and ERP. Thus, the network was optimized by using fewer variables. In spite of the above, we consider that resilience is key in the description of stress given the theoretical basis presented in this article, so that in one way or another it must continue to be partially present through other variables.

Regarding H3 (according to which it was expected to find higher levels of stress during confinement compared to previous months), it is not possible to confirm this hypothesis. It can be affirmed that people who perceive their experiences as stressful have been detected in this research, in line with what has been suggested by other studies (Balluerka et al., 2020; Ozamiz-Etxebarria et al., 2020; Rodríguez-Rey et al., 2020). However, the levels of stress shown between the months before and after the lockdown were not statistically significant, contrary to what was expected (Elsalem et al., 2020; Schlichtiger et al., 2020). During confinement, the society had to make a great effort to adapt to a hostile situation (Ando, 2020) and, despite this, no differences in stress levels were found in the present research. It is possible that during a stressful situation, new coping strategies were activated to achieve a new state of homeostasis. Similar results were obtained in Brazil where no significant differences were found in the stress levels before and after the start of COVID-19 and the related isolation measures (Amaral-Prado et al., 2020). It is possible that the absence of significant differences in stress levels is partially due to the nature of the measuring instrument selected. In the "Perceived Stress Scale" (PSS) (Cohen et al., 1983), participants were asked to analyze their situation in the past month. It is possible that if an instrument focused on a closer time scale had been used, for example, 1 week, a higher level of stress would have been perceived, as is the case in the research by Rodríguez-Rey et al. (2020) in which the "Impact of Event Scale-Revised" (Weiss and Marmar, 1996; Weiss, 2007) and "Depression, Anxiety, and Stress Scales" (Weiss and Marmar, 1996; Weiss, 2007) were used. This reopens a debate about whether the consequences of stress are manifested as a state or as a trait (Meijer, 2001) and about the need to try to delimit whether the instruments used in any research are associated with a stable quality or with a characteristic associated with the time of measurement. Therefore, further research on the construct of perceived stress is needed to understand the mechanisms that influence its genesis, development, and relationship to the timing of assessment.

With regard to H4, coping strategies are closely related to stress levels, so it is possible to confirm the hypothesis. When analyzing the network and the contribution of variables (standardized importance) to the ANN-1 and ANN-2, from a statistical viewpoint, coping strategies contributed the most to the network while sociodemographic variables had a secondary role. Thus, for example, the positive restructuring coping strategy played a relevant role in the RNA when analyzing its standardized importance. In this line, a previous research concluded that those coping strategies of a cognitive nature were essential in the processes of adaptation and effective personal adjustment, especially when they focused the positive side of the situation or, at least, attempted to show a positive attitude (Fernández-Cruz et al., 2020). Studies prior to confinement also found a relationship between the use of certain strategies, problem-solving focus, and lower stress levels in undergraduates (Keech et al., 2018). And conversely, it was also found in pre-confinement situation that focus on negative aspects of a stimulus were associated with higher stress scores (Gabrys et al., 2018). Social support has also been of relevant value in defining stress in the pre-confinement population (Erschens et al., 2018).

To sum up, this research illustrates that it is possible to construct a model based on the ANN to predict data variables presented before and after COVID-19 (Pirouz et al., 2020), and more specifically, in the educational field, where studies involving ANNs are scarce (Martínez and Morales, 2020).

Applicability and Implications

One of the interesting aspects of this research was the fact that we were able to collect information on stress, coping strategies and resilience during the months prior to the situation of confinement and after the decree of the state of alarm, although the latter could not have been foreseen and if it had been, a different research design would have been carried out. In any case, this research made it possible to monitor the psychological health of the university community and predict whether its member would experience stress, following the suggestions put forward by Amaral-Prado et al. (2020). In this sense, early detection is vital when faced with major disasters (Brooks et al., 2020; Ho et al., 2020) and ANN-based predictive models are effective tools for this purpose (Haghshenas et al., 2020). The ultimate purpose is to not only promote innovation, but also transfer knowledge through the design of preventive and intervention programs, which is one of the basic aspects of educational psychology (de la Fuente et al., 2018a) and the skills model (Amor and Serrano, 2018; Sanz, 2018). It is estimated that over time, the impact of psychological symptoms on health will be greater than the physical ones, unlike at the beginning of the pandemic (Cole et al., 2020). The use

of artificial intelligence is proving very useful in the early detection of certain variables with a high degree of accuracy (Luxton, 2014; Dabiri et al., 2017). Therefore, it is necessary to encourage studies that propose predictive models, which take into account the psychological variables. Another aspect to highlight is the increase of online tools to measure the use of coping strategies and stress levels using Academic Stress Utility (TM) as an example (de la Fuente et al., 2018b). The conduct of investigation based on digital means for data collection and processing leaves a door open to new possibilities. If data processing and predictive modeling based on artificial neural networks could be automated, the analysis of information and the generation of on-demand prevention and intervention programs could be streamlined.

The implications for stress prevention and intervention are broad. Predicting stress levels can help to act early, introducing stress reduction techniques and training programs for the development of functional coping strategies. Prolonged stress is associated with other physical and psychological problems, so preventing its occurrence would mean an improvement in the quality of life of people and an optimization of health resources. Likewise, initial teacher training could include instruction in those coping strategies that are more adaptive (Martínez and Morales, 2020). In fact, it would be interesting to consider the evaluation of such elements in the selective processes for access to the teaching profession. The inclusion of these factors could lead to an improvement in psychological health and, therefore, in educational quality.

Limitations

This study has certain limitations. First, it was cross-sectional in design. A longitudinal design would make it possible to follow up the symptomatology in the participants and draw long-term conclusions. Second, the size of the sample and the use of a non-probabilistic design preclude generalizations to the entire population. The geographical scope and professional profiles of the participants must be increased if the degree of generalization of the results is to be improved. However, it should be noted that there are previous studies using a relatively similar design in which it is possible to extract useful information for the scientific community. Such is the case of the recent study by Ozamiz-Etxebarria et al. (2020) in which the snowball probability sample was used. In terms of sample size, the present investigation also bears some similarity to other studies on the impact of COVID-19 such as that of Alkhamees and Aljohani (2021) with N=336. Newly, it is possible to analyze the information by assuming limitations of the design and biases in the decision making process during neural network design. Third, there are a number of extraneous variables that could be implicated in stress levels that have not been measured, such as the consequences of avoidance strategy use on healthy habits and these, in turn, on stress (Erschens et al., 2018; Taremian et al., 2018). However, it should be noted that the inclusion of many variables in the model could saturate its predictive capacity and make it less functional. In the design of artificial neural networks, the aim is to achieve a balance between the number of variables used and an optimal predictive capacity. If the number of factors is increased excessively to improve the predictive capacity of the model, the principle of simplicity of Okham's razor would be violated (Dayan et al., 2011). A final aspect to note is the use of the PSS. Although this instrument is valid and reliable (Remor, 2006), the temporal gradient of 1 month could be partially influencing the results, as mentioned in the discussion.

Future Lines of Research

The fact that there was a positive correlation between "resilience" and "*focusing on the solution of the problem*" and an inverse correlation with "*negative self-focus*" might suggest that resilience has an important bearing on the predictive capacity of ANNs; however, in order to achieve 88% predictive capacity, the resilience variable had to be removed from the algorithm. This indicates that the relationship between resilience and stress is more complex than initially assumed and needs further investigation. In line with the results of the present research, the study by van der Feltz-Cornelis et al. (2020) concluded that the promotion of resilience should not focus exclusively on stress, but rather address it from a multifactorial perspective, since the relationship is not as direct as one might think *a priori*. Additionally, it would be notable to introduce the variables depression and anxiety into the neural network model, since other studies have identified them to be closely related to stress (Rodríguez-Hidalgo et al., 2020), as well as develop an ANN whose dependent variable is the moment (pre- or post-confinement). Given what is stated in the discussion regarding the nature of the measuring instrument to measure stress, it is considered pertinent to use other scales that focus on a temporal gradient closer to the present moment, such as those used by Rodríguez-Rey et al. (2020). Eventually, the development of comparative studies would be essential to achieve an overall perspective and to design predictive statistical models that are more in line with reality.

CONCLUSION

This research examined the psychoeducational variables involved in the health emergency provoked in COVID-19 situation and months prior to the event. Younger people, who resorted more to the use of negative self-focus, open emotional expression, and avoidance coping strategies as well as had lower levels of resilience, were found to have higher levels of stress. In contrast, those who were older and with greater use of problem-solving focus and positive re-evaluation showed reduced levels of stress. In addition, 23.7% were identified to be stressed during the pandemic. No significant differences were found between pre- and post-confinement stress levels and possible explanations underlying this result have been discussed. Besides, correlational analyses showed that high levels of resilience were related to low levels of stress. The design for artificial neural networks illustrate that it is possible to achieve high predictive power (between 80 and 88%) in stress detection.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Granada. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

FM-R, JM-R, IM, and CR-E contributed to conceptualization and design. FM-R provided resources and contributed to project administration. JM-R did the data analysis and initial writing. IM performed the revision of the manuscript. CR-E did the final revision and adjustments to the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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No Children Should Be Left Behind During COVID-19 Pandemic: Description, Potential Reach, and Participants' Perspectives of a Project Through Radio and Letters to Promote Self-Regulatory Competences in Elementary School

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Around the world, many schools were closed as one of the measures to contain the spread of the COVID-19 pandemic. School closure brought about important challenges to the students' learning process. This context requires strong self-regulatory competences and agency for autonomous learning. Moreover, online remote learning was the main alternative response to classroom learning, which increased the inequalities between students with and without access to technological resources or for those with low digital literacy. All considered, to level the playing field for students without digital resources, there is an urgent need to promote self-regulatory competences through offline intervention solutions. The current paper describes a project with this purpose, using radio broadcasting and letters to reach elementary students without digital resources. Moreover, potential reach and participants' perspectives of the project implementation are presented and discussed. The project draws on a prior evidence-based story-tool intervention grounded on a self-regulated learning framework. The original intervention was set previous to the COVID-19 pandemic and was implemented in the classroom context (N = 1,103 students). Once the schools had been closed down, the mode of intervention was adapted with the collaboration of the community. Alternative solutions were developed as follows: (i) story chapters were read on the radio and students received to their homes a printed script, prompting reflection, and suggesting related activities; (ii) students were provided with the story-tool to read autonomously and received letters from the main characters of the story which included, for example, suggestions for activities and reflection. These two alternative modes of intervention delivery potentially reached 394 elementary students, including students with digital resources. Interviews conducted with a group of students were provided information about the positive aspects of these two modes of intervention delivery, perceived learning

(e.g., planning), constraints, and suggestions to improve the project. The current work is likely to merit attention from researchers and educational practitioners, given the need to use offline alternatives to provide support for students without digital resources to engage in autonomous learning during the pandemic period. This project may also be used as an alternative or a complementary solution to online modality.

Keywords: COVID-19 pandemic, offline intervention, self-regulated learning, story-tool, radio, letters, elementary school, school closure

INTRODUCTION

On the last day of 2019, a new coronavirus was potentially identified in Wuhan, China, according to the World Health Organization (2020). Rapidly, the virus spread to other countries, and 3 months later, the WHO classified COVID-19 as a pandemic. Meanwhile, around the world, several schools were closed or partially closed as a means to contain the spread of the virus (Viner et al., 2020). According to the data provided by UNESCO (2020), by April 2nd, 84.8% (about 1.5 billion) of students (considering all school levels) were affected by this health policy. The duration and extension of this policy in the school year of 2019–20 varied widely among the countries (from 2 weeks to 3 months) (Reimers and Schleicher, 2020). Focusing on the Portuguese case, schools were closed for more than one school term (i.e., more than 3 months).

As a response to the school closure, governments all over the world provided different solutions to ensure learning and instruction continuity, online, and/or broadcast remote learning being among the available modes mostly offered (Reimers and Schleicher, 2020). The latest UNICEF report on remote learning policies during the pandemic provides data based on more than 110 countries (UNICEF, 2020). For all educational levels, the digital mode to deliver learning contents, requiring computer, and internet access, were the most used, followed by broadcast responses using television, and then radio. However, in low-income countries, educational stakeholders used mainly the radio broadcasting to reach students. Surprisingly, there are no results about paper-based materials provision due to the lack of information about this solution (UNICEF, 2020).

The same report mentioned that 94% of the countries provided at least one educational response (yet it cannot be ignored that 6% did not provide any educational response to help students during the pandemic). Despite the positive news, researchers and educators lack data on the actual number of students reached by these emergency educational responses. The UNICEF (2020) report only provides data on the potential reach of such measures. These data were based on information gathered about the availability of technologies to study at home, and merit educational stakeholders' and researchers' attention. The report alerts that "at least 463 million—or 31 percent—of schoolchildren worldwide cannot be reached by digital and broadcast remote learning programs enacted to counter school closures" (UNICEF, 2020, p. 6). It is important to note that, due to the criteria chosen for data collection, this figure is clearly underestimated. For example, for statistical purposes, countries who were providing digital learning to the final year of elementary school, considered all elementary school students as being reached by this mode of delivering contents. Another interesting finding is that, globally, about 50% of the students who were attending elementary school by the time of school closure could not be reached by any alternative teaching mode. Considering these data, it is estimated that more than 215 million elementary school students were left behind without education during the school closure in 2020. In addition, a deep analysis allows the conclusion that the number of reached students varies between, but also within, countries. For example, data indicate that students from rural areas (even in developed countries) and low-income families were the most affected. The following quotation illustrates this proposition: "three out of four students who cannot be reached live in rural areas, but in low-income countries the percentage is even higher" (UNICEF, 2020, p. 11).

All of these data are disquieting and merit the attention of researchers and practitioners. For example, policy makers and educators could delve further into their analyses of the phenomenon by asking, "How many of the reached students actually used the provided educational solution(s) to help them learn and progress?" To the best of the authors' knowledge, there is currently no available data to answer this question, but the number of students benefiting from the alternatives modes of learning is likely to be significantly lower than 69%. In fact, the UNICEF report (2020) draws readers' attention to this issue. Even for students with access to technology at home, the number and type of devices available, the family environment, as well as the cultural values at home may limit the usage of devices (Moore et al., 2018; UNICEF, 2020; Xie and Yang, 2020). For example, during the period of confinement in 2020, parents teleworking and school-aged children studying in the same house with only one device available at home were likely to face difficulties to manage the usage of the device.

This alert is consistent with prior data. For example, the report by Moore et al. (2018), using data from a survey run in the United States, indicated that 14% of the participants (the majority being high school students from disadvantaged backgrounds) reported having only one device at home. Importantly, 56% of these students reported that this single device was a smartphone. Due to its characteristics, the usage of this type of device for school tasks (e.g., writing essays, completing complex project tasks) is limited (Moore et al., 2018). All considered, the potential reach of the educational responses through online remote learning could be significantly lower than that of which was disclosed in the UNICEF latest report (2020). In

addition, constraints and obstacles of a social nature should be acknowledged while discussing educational responses through online remote learning, for example, parents, students, and teachers' low digital literacy, pressure on children and youth to do household chores (especially in the case of girls) or other types of work to help the family (e.g., cook family meals, help in the local shop), or lack of parental support in using the online or broadcast educational responses (UNICEF, 2020; Xie and Yang, 2020). Besides the external factors that may compromise students' learning opportunities, literature has been alerting to the role played by motivation and self-regulation on students' school progress (Zimmerman, 2002; Rosário et al., 2016). For example, students working remotely on their school tasks with limited support are still expected to sustain motivation and avoid potential distractors (e.g., online games, text messages), define learning goals and strategies to complete school tasks, organize the environment, and manage time and the available and very often scarce resources, as well as their negative emotions, such as the boredom associated with being at home and far away from friends (Brooks et al., 2020; Xie and Yang, 2020).

Learning and working remotely on school tasks requires displaying agency and self-regulatory skills (e.g., Raffaelli et al., 2018). However, as prior research has been alerting, not all students self-regulate their learning tasks efficaciously (Zimmerman, 2002; Vandevelde et al., 2015; Heirweg et al., 2019). Acknowledging the challenges posed by the COVID-19 pandemic during school closure, it appears pressingly more urgent to provide students with support in order to help them develop self-regulatory skills. For example, the Chinese Ministry of Education has recently alerted teachers to the need of providing students with guidance and support "to scientifically formulate home-based learning plans, rationally select resources, and focus on developing students' autonomous learning ability" (Zhou et al., 2020, p. 504).

All considered, the purpose of the current work is 3-fold: to (i) provide a description of a project aimed to promote self-regulated learning (SRL) competences using alternative modes of intervention (i.e., local radio broadcasting and letters) as a way to reach students, particularly those without digital resources; (ii) analyze its potential reach; and (iii) explore participants' perspectives about their experience during this project.

The current project is grounded on the need to equip children with SRL competences vital to respond to numerous challenges raised by the pandemic context. We believe that the social and educational relevance of this project is likely to help educators and school administrators improve students' SRL competences and progress.

Theoretical Framework

Zimmerman model of SRL (2000) provides a relevant theoretical framework to support student independent remote learning, namely during the COVID-19 pandemic (e.g., Carter et al., 2020). This cyclical model considers the learning processes and motivational beliefs that occur before, during, and after a learning task, which correspond to three phases: forethought, performance, and self-reflection (Zimmerman, 2000, 2002). The forethought phase is comprised of two major aspects: (i) task analysis (where individuals define self-determined goals and a strategic plan to perform a task) and (ii) self-motivational beliefs, such as goal orientation (e.g., learning mastery-oriented), self-efficacy, outcome expectations, task interest, and task value (Zimmerman, 2000). Subsequently, the performance phase is comprised of two major aspects: (i) self-control (which includes the usage of different methods and strategies selected in the previous phase, such as self-instruction, imagery, attention focusing, and task strategies) and (ii) self-observation (e.g., overt and covert monitoring processes, such as self-recording and cognitive tracking of the task) (Zimmerman, 2000, 2002). Finally, the self-reflection phase encompasses: (i) self-judgment (e.g., self-evaluation of the final performance based on a criterion and attributing causal significance to the results) and (ii) self-reaction (e.g., self-satisfaction and adaptive or maladaptive reactions) (Zimmerman, 2000, 2002).

According to this model, each phase positively or negatively influences the following. According to the cyclical nature of Zimmerman's model, the last phase influences the subsequent forethought phase. As Zimmerman (2002) stresses in his model, these "self-regulatory processes are teachable" (p. 69) through direct instruction, modeling, guided practice, and feedback (Schunk and Zimmerman, 1997; Rosário et al., 2016; Quigley et al., 2018). Moreover, literature indicates that SRL enhances students' motivation and performance (Zimmerman, 2002; Mega et al., 2014). What is more, developing students' SRL is particularly important during school closure to prevent substantial academic losses (e.g., Azevedo et al., 2020).

Purpose of Alternative Modes of Intervention Delivery During COVID-19 Pandemic

In the context of the COVID-19 pandemic, recent research has been focused on the impact on the psychological state of children, adolescents, college students, and adults (Li et al., 2020; Zhang et al., 2020; e.g., Golberstein et al., 2020). For example, findings have shown the presence of negative feelings, such as frustration and boredom, symptoms of stress, depression, anxiety, insomnia, or exhaustion in these populations (Brooks et al., 2020; Li et al., 2020; Zhang et al., 2020). However, individuals (including children) are not just products of what happens to them; they can mobilize available resources to build adaptive responses to new events or ongoing changes in the surrounding environment (Bandura, 2006, 2018), in this case, to COVID-19 pandemic. SRL competences refer to a set of processes that allow individuals to proactively and intentionally control how they approach the personal, behavioral, and environmental aspects, along with the consequent impacts on their behavior, in order to achieve specific self-set goals (e.g., Zimmerman, 2000, 2002; Rosário et al., 2019b).

Promoting SRL competences is even more important during COVID-19 school closure (Xie and Yang, 2020). Due to the closure of schools, students moved from the classroom to the living room, and were expected to continue learning, despite receiving little support from teachers. Moreover, during this

period, many students had their caregivers working at home (e.g., housework, farming, teleworking) and the families were forced to compete for the available resources (e.g., internet spots, available devises, workspaces). These new and unexpected circumstances brought about important challenges for children and youth learning process, such as: the need to focus their attention on school tasks delivered online, follow classes or school meetings with poor internet connectivity or limited access, sustain motivation, or manage negative emotions while dealing with remote learning (Moore et al., 2018; UNICEF, 2020; Xie and Yang, 2020; Zaccoletti et al., 2020).

The self-regulated learning competences may be trained and consequently improved (e.g., Schunk and Zimmerman, 1997; Rosário et al., 2016; Azevedo et al., 2019). Grounded on a SRL framework (Zimmerman, 2000; Rosário et al., 2010), the research team designed various online (i.e., social media[1], synchronous sessions, blog, videos, google forms) and offline responses. These tools were based on an evidence-based story-tool intervention (i.e., "Yellow Trials and Tribulations"; Rosário et al., 2007b), and were designed with the purpose of promoting SRL competences in school-aged children during school closure. The current work addresses the offline interventions designed to reach students with low digital literacy or those experiencing a lack of technological resources during the COVID-19 health emergency.

Firstly, a description of the original intervention is provided, followed by the procedures involved in the design of the project, with two modes of intervention delivery: (i) radio broadcasting and (ii) letters. In the results section, a description of the project, its potential reach, and the participants' perspectives of their experience during the project was provided. Authors believe that this work may equip students around the world, especially those with low digital literacy or access to technological resources, to deal with the challenges of studying at home. In addition, this research contributes to mitigate the negative impact of school closure on students' learning.

MATERIALS AND METHODS

"Yellow Trials and Tribulations": Description of the Original Intervention

Grounded on the social cognitive theory, which assumes that contextual variables and learning settings play important roles in students' motivation and self-regulation, the story-tool intervention, "Yellow Trials and Tribulations," aims to promote SRL competences in children under 10 years old (Rosário et al., 2010). This story tells the adventures of the colors of the rainbow searching for their friend, Yellow, who disappeared in the woods (Rosário et al., 2007b). Anchored in the value that all people are important, and no one can be left behind, the colors put all their efforts to find their friend. As with any adventure, there are challenges and difficulties to overcome, and for the colors to be successful in their purpose, they have to learn and use SRL strategies. Children using this story tool will be encouraged to follow a metacognitive approach while reading the chapters through the characters' experiences, and by reflecting on the activities developed in each session of the intervention. Educators are expected to help children develop declarative (e.g., what is a plan), procedural (e.g., how to plan), and conditional (e.g., when and why they should plan) knowledge of the SRL processes and strategies learned (Rosário et al., 2010, 2017).

In this sense, characters model how to "think before, during, and after" acting, following the cyclical model PLEE—the acronym for PLanning, Execution, and Evaluation (Rosário et al., 2010, 2017), which is rooted in the SRL model by Zimmerman (2000). The PLEE model claims that the SRL is cyclical and adds a recursive loop to the process: each phase of the model is embedded within the whole sequential loop (Rosário et al., 2017). For example, regarding the planning phase, children are introduced to the concept of goal setting and are expected to learn how goals are defined, as well as design plans using strategies likely to help them achieve particular self-set goals. Children learn that in the following step, the execution phase, they are expected to put the plan into practice. To this aim, they are expected to monitor the action process, for example, by analyzing the (in)effectiveness of the strategy used to attain the goal set and making adjustments if necessary. Finally, children learn the importance of closing the first iteration of the SRL cycle by evaluating the final output. In this phase, children are encouraged to analyze if everything has gone as planned, if their efforts in doing tasks were successful, and reflect on the reasons for their success or failure (e.g., Rosário and Polydoro, 2014; Rosário et al., 2017). This evaluation informs a new planning phase, resuming the SRL cycle (Rosário et al., 2010). In sum, this project aims to promote children's autonomy and agency (i.e., set and sustain intentional actions toward a self-determined goal) in the learning process (Bandura, 2006; Rosário et al., 2010, 2017).

Prior to the pandemic, the intervention with this story tool was carried out in the classroom on a weekly basis, for

[1]An online response called "COVID-19 Trials and Tribulations" was developed and launched on Facebook® (Covid-19 em Sarilhos) and Instagram® (@covid19_em_sarilhos) 1 week after school closure. Chapters of the story "Yellow Trials and Tribulations" were shared with the followers in video format, every week. In addition, the project shared, every day, suggestions with activities sponsored by the colors of the rainbow. Activities were focused on four domains:

1. Learning something new—This domain was important to convey the message that, despite the school is closed due to the pandemic, the learning process continues (Zhou et al., 2020).
2. Collaboration at home—During the quarantine period, families had to reorganize/develop new household routines, requiring the collaboration of all family members. This domain was developed to respond to this reorganization and help keep home organized. Research has indicated the benefits of children collaboration in domestic chores, namely, in promoting their self-efficacy, satisfaction with life and prosocial behavior (e.g., White et al., 2019).
3. Helping someone—intends to instigate social responsibility in children during the pandemic period. Recent studies with children and adolescents have indicated higher social responsibility was associated to more social distancing behaviors; the latter are essential to fight the spread of the virus (e.g., Oosterhoff et al., 2020).
4. Leisure/Physical activity—this domain was developed to promote physical activity and leisure as a way to overcome the sedentary lifestyle that can result from the quarantine period (Dunton et al., 2020) and to stimulate the well-being and healthy development in children (Kuykendall et al., 2015; Freire et al., 2016).

∼60 min. Sessions of the intervention were structured as follows (Rosário et al., 2007a, 2010): setting the scene (i.e., creating the environment for the work routine; for example, students wear a yellow shirt and join together in the space created for this purpose), examining advance organizers (Ausubel, 1978) (i.e., reviewing prior events of the story and lessons learned), reading the chapter(s), along with exploration and reflection of the messages conveyed, and finally, a practical activity and take-home message. It is important to note that the reflection and discussion of the SRL processes and strategies conveyed in the chapters followed a microanalytic methodology and the three types of knowledge (Rosário et al., 2017). This methodology helps children develop strong knowledge about the various SRL strategies, and the opportunity to discuss how they can implement them, despite obstacles and hardships (Núñez et al., 2013; Rosário et al., 2017).

The intervention has been conducted with 4th graders from urban and rural contexts and has been shown to significantly enhance self-reported SRL competences and self-efficacy (Fernandes, 2009; Högemann, 2011, 2016), as well as observed behavioral (e.g., punctuality, class participation) and cognitive (e.g., asking for help, verbalizations related to the task planning) engagement in the classroom context (Rosário et al., 2016). Qualitative data gathered from post-intervention meetings with the teachers of the participating students showed positive results. For example, teachers enrolled mentioned that students had started using PLEE in their daily activities in contexts outside of the classroom (e.g., bake a cake at home, planning games in the playground of the school), showing knowledge transference (Rosário et al., 2019a). The vast corpus of research on this story tool has provided evidence of the benefits of this narrative-based intervention on students' SRL competences development.

Intervention Setting Prior School Closure

Two educational stakeholders (i.e., Calouste Gulbenkian Foundation and Integrated and Innovative Plan to Combat School Failure of the Trás-os-Montes Intermunicipal Community) engaged in the promotion of students' socio-emotional skills, learning autonomy, and consequently their academic success through evidence-based interventions funded the current intervention. The research team, GUIA, from the School of Psychology at the Universidade do Minho was selected to set the evidence-based intervention, "Yellow Trials and Tribulations," to promote SRL in elementary students from several schools across the country. According to the protocol of this research tool, the intervention must be implemented by a professional (e.g., teacher, psychologist, social educator) trained for this purpose by the research team. After each session, the implementer completes a session sheet to self-evaluate the session (e.g., protocol of the session compliance) and identifies difficulties to discuss with the research team. All session sheets are analyzed by the research team, and then followed up through a meeting with the implementers via videoconference to monitor the intervention implementation on a monthly basis. Eventually, the research team trained 59 professionals between May and December of 2019. Training lasted 50 h and followed a theoretical (e.g., motivation theories, SRL models) and a practical approach (e.g., simulation of a session). At the end of the training, in the 2019/2020 school year, the story-tool intervention was expected to be conducted at 11 schools from distinct urban and rural contexts in Portugal.

The ethics committee of the University of Minho, and Ministry of Education approved the intervention and its assessment protocol. The parents or caregivers of the students enrolled provided written informed consent to the distinct phases of the research (i.e., intervention, self-reports, interviews) in accordance with the Declaration of Helsinki.

Finally, a total of 1,103 students from 57 classes of the 3rd (typically 8 years old) ($n = 550$ students) and 4th (typically 9 years old) ($n = 553$ students) grades were enrolled in the intervention. By the time of school closure in Portugal (March 16, 2020), as a response to contain the spread of the COVID-19 pandemic, implementers had conducted a few sessions of the program (i.e., ranging from one to five sessions). In detail, the children enrolled had already read one up to five out of 17 chapters of the story-tool when the schools closed.

Procedures for Alternative Intervention Development and Assessment

Due to the unexpected school closure, the research team started working on alternatives to continue delivering the program. The alternative intervention solutions needed to acknowledge and respond to the educational needs of the children without technological/online resources or with low digital literacy during school closure. To this aim, the research team followed two steps: (i) conducting a needs assessment, and (ii) setting a collaboration ground with the coordinators and implementers of the story-tool intervention.

The needs assessment was conducted through a video conference with the implementers of the intervention that took place 1-week post school closure. During this meeting, implementers reported (i) the challenges they were facing while teleworking (e.g., balancing teleworking and caregiving [this was particularly challenging for parents of very young children], difficulties to adjust educational support to children needs, and high workload); (ii) the responses taken by the school administrators to help families cope with the school closure (e.g., remote learning, school tasks delivered by e-mail, or printed in the school or the City Hall and delivered to the students' homes by police officers); (iv) data on the available resources and conditions of the participating children and families (e.g., no technological or online resources, parents working in farms or factories with limited ability to support children learning, limited time for children to use the computer due to parents' teleworking, and limited space at home to manage siblings' remote learning); and finally, (v) overload of school tasks). Some implementers reported that several City Halls were providing computer and internet connections to students from low socioeconomic backgrounds. This was an important resource for many families. Still, for those with low digital literacy, this was a social measure of limited use. Moreover, implementers declared their willingness to continue the intervention following alternative

modes of delivery, and to further discuss the suggestions presented by the research team. Still, implementers were not able to decide by themselves, if, how, and when to follow through with the interventions interrupted. Teachers and parents were experiencing distressing situations with the school closure, and the school administrators had to evaluate the feasibility of continuing the project using alternative modes of delivery.

A few weeks later, the research team and the implementers met through videoconference to learn of their decision regarding the intervention, and to discuss possible solutions. Implementers and research team members agreed that potential solutions were needed to prevent leaving students behind and should be grounded in the core features of the original intervention "Yellow Trials and Tribulations."

Eventually, in three of the 11 schools enrolled, the implementers decided not to offer offline modes of intervention, because these schools were already delivering contents via online modes. On the contrary, eight of the schools enrolled declared to be willing to continue the intervention following offline modes of delivery (six decided to deliver the intervention via offline and online modes, and two decided to deliver the intervention exclusively via offline modes). Finally, discussions between the research team and the implementers resulted in two alternative solutions, to deliver the intervention via: (i) radio broadcasting or (ii) letters. The former was suggested by one implementer who had connections with a local radio. The mode of delivery and the materials used to reach students were planned collaboratively between the research team and the implementers. The second mode of delivery was proposed by the research team, given that some schools already had someone responsible to deliver school materials by mail or in person. The school which had an implementer with connections to a local radio decided to use this mode of intervention delivery, whereas the remaining implementers decided to use the letters. Both modes are further described in the results section.

To assess these two modes of intervention delivery, the research team decided to use descriptive statistics of potential reach—the percentage of children eligible by the implementers to participate in the offline modes of intervention delivery. Eligible children were: (i) those without technological/online resources, or (ii) those recently granted internet connection (after school closure), or (iii) those identified by the implementers as having low digital literacy to enroll in the online mode of intervention delivery. Moreover, based on internet connection data provided by the implementers, the research team decided to estimate the number of children that would not be reached if no offline modes of intervention delivery were implemented. Additionally, the research team and the implementers discussed other methods to assess the project impact. The academic-community collaborative team was aware that the methods to collect data should not be an additional load to children and families already feeling overwhelmed. Finally, interviews with the participating students were the chosen method of data collection (see Data Collection subsection).

Participants Selected for Interviews

In order to assess the project, 30 students of each mode of intervention were randomly selected to be interviewed. This number of students is expected to ensure enough diversity and the saturation of data patterns (Warren, 2002; Baker and Edwards, 2012). Parents of these students gave their consent to this interview.

Regarding the intervention through radio, four out of the 30 participants selected for the interview were excluded for different reasons (i.e., one did not pick up the phone call to schedule the interview and three parents influenced the child's answers during the interview). Unexpectedly, 18 children (nine girls) reported not to listen to the radio. Despite this, the research team decided to include them in the current study to further understand the phenomena (see Results section). In this group of children (Mage = 8.67; SD = 0.70), 13 were from the 3rd grade and five were from 4th grade. Finally, eight children (five girls) reported listening to the radio. In this group of children (Mage = 9.00; SD = 0.71), five were from the 3rd grade and three were from 4th grade. These participating students were from a deep rural context.

Regarding the intervention through letters, of the 30 participants selected for the interview, 14 were excluded due to two reasons (i.e., nine did not pick up the phone call to schedule the interview, and five parents influenced the child's answers during the interviews). In the end, 16 children (Mage = 9.21; SD = 0.58), four from the 3rd grade (two girls) and 12 from 4th grade (four girls), were interviewed. These 16 participants confirmed they had received and read the letters. The participating students were from a deep rural context.

Data Collection Through Interviews

As previously mentioned, interviews were given in order to assess the two modes of delivery (radio and letters) of the project. The research team conducted the interviews with children who provided informed assent and whose parents provided informed consent. During the month of July, trained research assistants conducted interviews by phone call, video call, or videoconference (e.g., ZOOM), according to the participants' preference. Regarding the video call/video conference interviews, the recommendations of the literature (e.g., Irani, 2019) to ensure the privacy of the participants (e.g., use of headphones during the interview) were followed. Each interview lasted ∼25 min.

The semi-structured interview script included open-ended questions addressing participants' experiences during the confinement period and home school (e.g., conditions of quarantine, resources, needs, and others), along with specific questions to assess their experiences during each mode of intervention delivery (**Table 1**). These questions were previously asked to three children in order to ensure comprehensibility. It is important to note that these three children did not participate in the study. No changes were made to the semi-structured interview script.

Data Analysis of the Interviews

Interviews transcriptions were independently analyzed by two research assistants using content analysis, following a deductive and inductive approach (Bardin, 1996). Regarding the deductive

TABLE 1 | Semi-structured interview script.

Radio	Letters
Now, I would like you to tell me how following along with the story "Yellow Trials and Tribulations" went through the radio.	*Now, I would like you to tell me how following along with the story "Yellow Trials and Tribulations" went as sent to you in the "Letters from the Rainbow."*
How was it for you to follow the colors adventure through the radio?	*How was it for you to receive these letters?*
How did you prepare yourself to listen to the chapters on the radio?	*What do you think of the activities that were presented by the Colors of the Rainbow?*
What activities did you do after reading the chapter(s) on the radio?	–
What did you learn?	*What did you learn?*
How can you use what you have learned on a daily basis? Please, give me some examples.	*How can you use what you have learned on a daily basis? Please, give me some examples.*
Imagine that you are now in the next year and that you are participating again in this project. What suggestions would you give to help children learn the lessons from the colors of the rainbow?	*Imagine that you are now in the next year and that you are participating again in this project. What suggestions would you give to help children learn the lessons from the colors of the rainbow?*

approach, prior to the analysis, a codebook was created based on the PLEE theoretical model (Rosário et al., 2010). Firstly, transcripts were read several times to get an overview of the data. Then, a deductive approach was used to code data, fitting data to the theoretical-driven codes (e.g., planning, executing, evaluating). The inductive approach was followed to identify new codes emerging from data (e.g., absence of teacher support, high workload). Then, data were aggregated, and final categories were selected (e.g., perceived learning, constraints). When discrepancies were found in the coded material, the researchers discussed them in order to reach a consensus. After this coding process, data were analyzed (e.g., categories frequencies), reorganized, and then interpreted. QSR International's NVivo10 was used to support all data analysis. Inter-rater agreement was calculated to ensure the precision of the coding scheme. The Kappa value was 0.91 and 0.86 for the interviews focused on the radio and letters, respectively; these values are considered "almost perfect" according to Landis and Koch (1977, p. 165).

RESULTS

This section addresses the results of the three purposes of the current work: (i) description of the two modes of intervention delivery (i.e., radio and letters), (ii) potential reach, and (iii) participants' perspectives about their experience throughout the intervention.

Description of the Offline Intervention Modes of Delivery

Story Reading on the Radio and Paper Activity

This mode of delivery for the intervention involved the dramatized reading of chapters from the book, "Yellow trials and tribulations," on the radio over the course of 6 weeks (every Tuesday, from 7:10 to 7:30 pm). In addition, a printed script (see **Supplementary Figures 1–3**) was sent to the participants through mail or via personal delivery (e.g., teacher). In this offline delivery mode, the script for each week included: the goal(s) for the week, advanced organizer (included after the first week of radio broadcasting), book excerpts and corresponding questions to prompt reflection, and finally a reminder of the following radio broadcasting session. To complement, the script included a consolidation activity designed to promote learning and strengthen the lessons learned (e.g., each activity was related to the chapters previously read). Moreover, families were invited to participate. Finally, the script ended with "today's lesson" question (e.g., "What was the most important thing you learned from this week's chapters?"). **Table 2** illustrates the anatomy of the intervention, providing the goals for each week, the chapters and the activities proposed, as well as a brief description of each component.

At the end of the program, children were invited to send all the material to their school/teacher. For that purpose, each received an envelope in the first week.

Letters From the Colors of the Rainbow

This mode of delivery for the intervention was developed through adaptations of the contents of the online and social media project, "COVID-19 in trials and tribulations" (see footnote 1) to an offline mode of delivery (i.e., letters). In order to make these materials visually attractive to children, all letters were stamped with the shape of a drop (inspired by the drops of the "COVID-19 Trials and Tribulations" project). Each drop was designed to be colored and cut out by the participant, so that by the end of the intervention, this collection of colored drops could form a rainbow (see **Supplementary Figure 4**).

In each letter, the protagonist was one of the colors of the Rainbow (e.g., Blue). In addition, every letter included three suggestions of activities promoted by the protagonist, each based on the following domains (see information in the footnote): (i) Learning something new (e.g., learn different drawing techniques); (ii) Collaboration at home (e.g., make the bed); (iii) Helping someone (e.g., call a friend to help with homework); or (iv) Leisure/Physical activity (e.g., different suggestions for physical exercise).

In addition to these activities and suggestions, other components were added to the letters intermittently. For example, the sections "solutions" and "week reflection." The former provided the correct answers for the queries in the

TABLE 2 | Anatomy of the adapted intervention using radio broadcasting: a week-by-week description of the goals, key components and related activities.

S/W	Goals	Key components	Chapters/Activity	Brief description
0	To explain and instruct families about the intervention (e.g., main steps).	Orientation guide	–	This guide describes the steps of the intervention. Participants receive an envelope to keep track of their activities during the intervention.
1	To analyze and anticipate consequences of the adopted behaviors. To value the role of effort and commitment in the learning process: Capacity vs. effort.	Reading	1, 2, 3, 4	The colors of the rainbow (the main characters of the story) are introduced. Yellow runs away from the rainbow and the other colors decided to start a quest in search of their friend. During this mission, they encounter characters that help them with valuable lessons.
		Activity	*Be a Teacher for 1 day*	Children are asked to imagine that they are teaching the characters of the story (e.g., the deer that only wanted to follow his will) and to write them three pieces of advice to help them overcome their difficulties.
2	To learn about the three phases of the self-regulatory process (planning, execution and evaluation—PLEE).	Reading	5, 6, 7*	The colors encounter new characters who teach them the PLEE model.
		Activity	*Make a colorful fruit salad*	Children are asked to make a colorful fruit salad with a family member, applying the PLEE process.
3	To analyze feelings and behaviors. To reflect on the consequences of behaviors over time (short, medium, and long term). To learn to control impulsivity, developing reflexivity.	Reading	8*, 9, 10	During their mission, the colors watch a group of *problems* having a picnic (e.g., lie, fear).
		Activity	*Emotions*	Children are invited to think on the *problem* that was more "present" throughout their own day, and on strategies to "smooth" it.
4	To identify the three phases of the PLEE process in stories and in everyday situations. To understand the concept *monitoring.*	Reading	11, 12	These chapters tell the story of "The Three Little Pigs." The colors apply the PLEE model to the story.
		Activity	*Create a house, applying PLEE*	Children are asked to build a miniature house while applying the PLEE model and monitoring the process.
5	To understand the steps of the problem-solving process. To apply these steps to specific tasks.	Reading	13, 14	The Pirate Tree gave riddles to the Colors of the Rainbow.
		Activity	*Be a detective for 1 day*	Children are asked to play detective and help the Pirate Tree solve his problem.
6	To take responsibility for our own actions: the importance of error. To reflect on the lessons learned.	Reading	15, 16, 17	The colors found an injured bird and helped him.
		Activity	*Sentences and lessons to keep*	Children are asked to complete activities (e.g., select important sentences from the story that had stuck with them throughout the journey, and think what lessons they took from it).

S/W, Sessions/weeks.
**In the original intervention, these chapters were not included. In this mode of intervention delivery, these chapters were read on the radio, but there were not included in the session activity (printed script of the session).*

previous week's letter, allowing children to check their previous answers; and the latter, taken from the story, "Yellow trials and tribulations," was developed to promote reflection on SRL important concepts (e.g., PLEE).

In sum, the new program, "Letters from the rainbow" was built to accompany children and their families until the end of the 3rd school term (the final term of the school year, typically, from April to mid-June). In total, the program consisted of a 12-week duration, and students were delivered 12 letters in addition to the welcome and the goodbye letters. The "Welcome Letter" aimed to explain to the families how the project works in this modality, and the "Goodbye Letter" was designed to be delivered at the conclusion of the program to thank all of the participants for their participation. Finally, "extra letters" termed "Tips from the Rainbow" were delivered occasionally, as a way to help children develop positive study strategies to apply in schoolwork during the 3rd term (e.g., how to build a timetable using PLEE), similar to the content published in the social media pages, "COVID-19 in trials and tribulations" on Facebook or Instagram.

For further details, **Table 3** presents the goals and the anatomy of the intervention (detailed description of the letters and activities for each domain). Complementary to the letters,

TABLE 3 | Anatomy of the intervention using letters: a week-by-week description of the goals, domains, and related activities.

W/S	Goals	Letters	Domains	Brief Description
1	To start the interaction with the children. To remember the characteristics of the colors. To explain and instruct families about the intervention (e.g., main steps).	Welcome letter	–	This is a welcome letter, where Yellow and the colors of the rainbow are introduced. The Letter explains how the intervention will work: what is expected, the weekly plan, etc.
	To promote physical activity and the application of PLEE. To promote logical thinking, problem-solving strategies, and the application of PLEE. To stimulate an organized physical space.	Letter 1	Leisure/Physical activity	*Basket and Socks*: The challenge is to throw the socks in the basket to gain muscle and try to hit as many socks in a basketball box.
			Learning something new	*Math trouble*
			Collaboration at home	Clean the living room ("Have you tidied up the room today?"). For example, fold the blankets or arrange the sofa cushions.
2	To promote logical thinking and problem-solving strategies, applying PLEE. To promote the knowledge of other forms of communication, and foster curiosity:	Letter 2[a]	Leisure/Physical activity	*Proverbmojis:* Discover what popular sayings are behind the emojis sequence.
	To promote communication with family or friends, even in difficult times.		Learning something new	*Sign Language:* Here is a picture of the alphabet of Portuguese sign language. The challenge is to try to form words.
	To evaluate and correct the previous activity.		Helping someone	*Call:* make a call to a friend or a family member and enjoy.
3	To promote the search for information using different sources.	Letter 3[a]	Learning something new	*Michelin star:* The challenge is to build a *recipe book.* Also, call a family member or friend to share favorite recipes.
	To promote physical activity. To promote interaction with the family. To reflect on the importance of organization (e.g., home, feelings).		Leisure/Physical activity	*Move it:* "What is your favorite exercise in physical education classes?". Do this exercise and ask your family to do it with you.
	To evaluate/reflect on the consequences of lack of organization (e.g., school material, feelings). To foster awareness of what we feel and how it affects us.		Week reflection	*"There is a place for everything, and everything must be in its own place!"* (Lizard Stone, p. 12)
4	To promote organization. To provide a moment to relive past experiences and people. To promote interaction between family members.	Letter 4[b]	Collaboration at home	*Photoland:* Photographs are a way to relive the adventures we have been through! Take this time to revisit some photos and organize them by important dates or events.
	To promote physical activity. To foster interaction between family and neighbors. To help family and friends to do different activities.		Helping someone	*Partyland:* Choose a funny song, go to the balcony/window, and dance. Invite the neighbors to dance on their balconies too! it will be a Big Party.
	To promote planning and reflection on activities after quarantine. To promote interaction with the family. To foster creativity (e.g., decoration of the magic pot).		Learning something new	*Magical Pot:* (1) Choose a bottle and decorate it; (2) Take small papers and a pen; (3) Write post-quarantine goals and save them in the magical pot.
5	To create funny and interactive moments with the family. To foster creativity. To exercise thinking by guessing. To promote support by sharing a story. To promote interaction with other people (e.g., tell stories over the phone).	Letter 5	Leisure/Physical activity	*Mime game:* Play this game with the family (e.g., imitate animals, and ask other members to guess which animal you are imitating).
	To practice reading. To foster creativity—in the case of children who choose to tell a story of their own.		Helping someone	*Tell a story:* The challenge is to take your favorite book and read the story to someone of your choosing (even over the phone).
	To promote reflection about goals setting and the importance of defining a path to follow.		Week reflection	*"There is a way, there is always a way"* (Hiccups River, p. 15)

(Continued)

TABLE 3 | Continued

W/S	Goals	Letters	Domains	Brief Description
	To promote time management, considering all the activities students have (e.g., attending classes, studying, playing). To explain the purpose and the construction of a timetable, using PLEE.	Extra Letter 1	–	To complement the usual letters, this extra letter was developed to help children learn more about time management and how to be organized during their school tasks. In addition, by applying the PLEE model to this task, children learn to identify and understand the three phases of the PLEE process in everyday situations (e.g., "to build a timetable, we must plan, that is, think before what tasks we have…").
6	To create awareness on the importance of recycling. To promote evaluation about current recycling practices. To promote recycling. To foster creativity.	Letter 6[b]	Collaboration at home	*"Do you recycle?":* IF YES, then check if everything is done properly and leave reminders in each recycling bin informing about the materials and the conditions that should be put in the bin; IF NO, then it's time to start.
	To promote thinking.		Learning something new	*Animals in letters:* Challenge yourself in a word search puzzle
	To create fun and relaxing moments with the family.		Leisure/Physical activity	*Bowling:* Challenge your family to a Bowling game and learn who can knock down more pins. The pins can be bottles or other objects you find at home.
7	To encourage the reduction of water usage through planning creative strategies (helping the planet). To foster awareness on the importance of water.	Letter 7[a]	Helping someone	*Saving water:* Choose a 5-minute song and bathe while the music is playing!
	To promote thinking and creativity. To promote reflection on the importance of patience. To have the opportunity to evaluate and correct the previous activity.		Leisure/Physical activity	*Stop game:* It's a really fun game and helps to exercise your brain. Challenge the family to play! Together, pick a letter of the alphabet and have each player write a list of words for each categoric beginning with the chosen letter. The first player to write a word for all of the categories has to say "STOP."
			Week reflection	*"Those who never give up will succeed"* (Hiccups River, p. 16)
8	To promote thinking. To create fun moments with the family. To promote logical thinking and practice.	Letter 8[b]	Learning something new	*Math Challenge:* Try to complete this multiplication table.
	To foster awareness on the importance of water.		Leisure	*Treasure Hunt:* Spend your energy by doing a treasure hunt with your family.
	To evaluate and find situations in which water is wasted.		Collaboration at home	*Dripping taps inspector:* Did you know that a tap dripping every 5 s for 24 h can waist 30 liters of water? The challenge is to reduce this number to zero! Inspect the taps of your house.
9	To recall positive moments from a new and challenging situation (e.g., social isolation). To promote creativity.	Letter 9	Helping someone	*Gifted Memories:* Exceptional moments deserve unrivaled memories! Choose a happy moment from the past few weeks and draw it!
	To promote the use of protective measures against the Coronavirus.		Collaboration at home	*Slowly you go far:* To walk you need to think ahead, be prepared, and be in a good physical condition! The challenge is to clean the soles of your shoes so that you can walk further and with style.
	To promote reflection on the importance of the agency, and the importance of others in this competence.		Week reflection	*"Learning more and better depends, above all, on what each one does"*(uncle *Jarbinhas*, p. 21)
10	To practice the content covered in classes and to promote thinking through a challenging activity that promotes student involvement.	Letter 10[b]	Learning something new	*Magical Square:* Complete the following math challenge.
	To promote planning skills while playing games. To promote fun moments with the family through the game.		Leisure/Physical activity	*Chinese Little Monkey:* Play this traditional game with the family.
	To help promote environmental awareness through the reuse of sheets of paper.		Helping someone	*Detective Paperwork:* How many unfinished notebooks or sheets written on one page do you have at home? Put all these sheets together and use them.

(Continued)

TABLE 3 | Continued

W/S	Goals	Letters	Domains	Brief Description
	To promote reflection and monitoring of daily feelings. To promote reflection on how different emotions influence the ways in which we behave and perform tasks.	Extra Letter 2	–	Designed as a complement, this letter was developed to help children to reflect further about daily feelings and emotions.
11	To encourage help among colleagues during school exercises. To practice asking for help (e.g., when having doubts in school).	Letter 11	Helping someone	*TeleProf*: Do you have questions about this week classes? Call a friend and see whether they can help you! P.S. you can do the opposite: help your friends!
	To promote communication with colleagues. To promote planning skills.		Leisure/Physical activity	*Hidden in the flour:* Ask someone to hide sweets in a bowl of flour, so that you can search for them using only your mouth, without your hands. But first think on your strategy.
	To promote fun moments, through the game. To promote reflection on the importance of initiative.		Week reflection	*"With closed wings, no one learns to fly!"* (Bird-Teacher, p. 21)
12	To promote logical thinking. To promote creativity.	Letter 12[b]	Learning something new	*Challenge of the Squirrel, Sarabico:* Find the mirror image of the following figure.
	To promote planning while doing outside activities (e.g., camping, party) in the home environment.		Helping someone	*Congratulations in time*: Create a calendar with all the months of the year and indicate the birthdays you want to remember.
			Collaboration at home	*Partyland*: How about having a party in a new place today? Create your own tent and have fun.
	To thank the children for their participation. To emphasize the importance their participation throughout the project. To summarize lessons learned. To encourage the importance of help others.	Goodbye letter	–	This was a goodbye letter, where the colors have the opportunity to thank the children for their participation.

Children were provided the book Yellow's Trials and Tribulations to read autonomously.
S/W, Sessions/weeks.
[a] *Solutions—This activity was added to the letters in specific weeks of the intervention. In this activity, solutions of the activities from the previous letter were presented to the children.*
[b] *The Week Reflection proposed by the research team was also added to the letters in specific weeks of the intervention.*

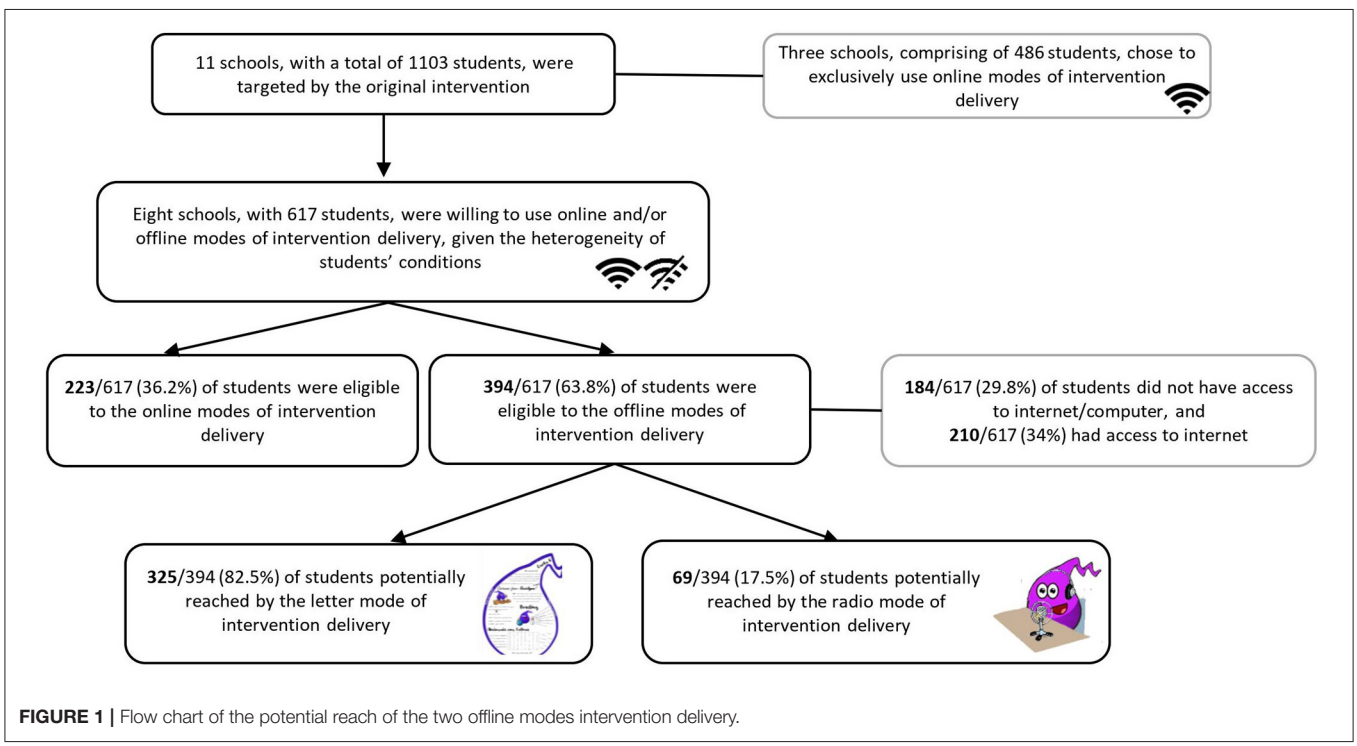

FIGURE 1 | Flow chart of the potential reach of the two offline modes intervention delivery.

TABLE 4 | Estimation of children not reached if the offline modes of intervention delivery were not implemented (by school), based on the number of students without internet access.

Schools	Students eligible to the offline modes of intervention delivery (*n*)	Students without access to Internet (*n*)	Students without access to Internet (%)
1[a]	39	20*	51.3
2[a,b]	66	0	–
3[a]	7	7+	46.7
4[a]	6	6	16.2
5[a]	9	9	8.3
6[a]	183	92*	50.3
7[a]	15	15	68.2
8[c]	69	35*	50.7

[a]*Letters as mode of intervention delivery.*
[b]*In this school, the implementer was not able to provide online sessions, despite the students having internet connection in their homes.*
[c]*Radio as mode of intervention delivery.*
**In these schools, the number of participants without internet was not exact. Therefore, we estimated by 50%, the percentage of children without access to the internet.*
+In this case, participants reported no access to internet and computer.

chapters of the book, "Yellow Trials and Tribulations" were previously sent to the children through mail or via personal delivery (e.g., teachers), so that participants could read the book autonomously.

Project Potential Reach

The project post-school closure was designed to include children from the 3rd and 4th grades with limited access to technological resources (e.g., computers, internet). These children were attending schools that had been implementing the original intervention "Yellow trials and tribulations" prior to the school closure due to the COVID-19 pandemic. From the 11 schools enrolled, eight declare their willingness to continue the intervention using offline modes of delivery.

Figure 1 shows a flow chart presenting the potential reach of the program using radio broadcasting and the letters as modes of delivery. The eight schools enrolled included a total of 617 students. From this group, 394 participants were identified as having been offered one of the offline intervention modes of delivery. Based on these data, both modes of intervention delivery potentially reached 63.8% of students from the sampled schools. **Figure 1** highlights that, from the 394 students, 184 (29.8%) had no computer or access to the internet, while 210 (34%) reported to have access to internet. This last result is due to three reasons: (i) the City Hall had recently provided internet access to the children (after school closure), so implementers decided to include them in the offline mode of intervention delivery; (ii) the implementers considered that the children did not have the digital competences to participate in the online modes of intervention delivery; and (iii) one implementer did not have technological resources to provide online sessions.

Table 4 presents an estimation of the children that would not reach in the case of non-existence of the offline modes of intervention delivery for each of the participating schools. Results show that the majority of the schools had a high percentage of children with no access to the internet. Specifically, five of the total eight schools had ∼50% of children without technological resources. Moreover, it is important to note that one group of students enrolled in this project had access to the internet (School 2, see **Table 4**). In this particular case, despite these students having internet connection in their homes, the implementer was not able to provide online sessions. This school and its students accepted to enroll in this alternative intervention and participated until the end.

Story Reading on the Radio and Paper Activity

Assessment needs data showed that 69 (17.5%) children from the 3rd and 4th grades were potential participants in this delivery mode. In the beginning of this mode of intervention, the majority of the participants did not have access to the internet nor to other online resources, however, over the course of the program, the resources were provided to this group of children by the City Hall. Therefore, for this specific group of participants, the percentage of children not reached in the case of non-existence of this offline mode of intervention delivery was estimated, considering 50% of the cases without technological resources ($n = 35$ participants).

Letters From the Colors of the Rainbow

Assessment needs data showed that 325 (82.5%) children from seven schools were potential participants in this format delivery. In this group, about 37.8% of the students did not have access to the internet throughout the intervention. Two schools did not report data on children with no access to the internet/computer. In both schools, the percentage of children not reached in the case of non-existence of this offline mode of intervention delivery was estimated by reporting 50% of the cases.

Qualitative Data Findings

This study explored children's perspectives of their experiences regarding the implementation of offline modes of the "Yellow Trials and Tribulations" intervention. The current section presents findings for both modes of delivery, radio broadcasting and letters. The frequency of occurrence criterion of the categories defined by Hill et al. (2005) was used to report

results. Specifically, results from "variant" (i.e., more than 3 cases) categories are reported to provide diverse perspectives of the participating children. Throughout this research report, quotes from participants are presented to illustrate data.

Story Reading on the Radio and Paper Activity

When participants talked about their experience during the radio implemented intervention, four categories were identified in the analysis of the interviews: positive feedback, perceived learning, constraints, and suggestions. Children provided positive feedback about the possibility of continuing to listen to the story through the radio. Otherwise, as some mentioned promptly, they would not learn how the colors found their friend Yellow that run from the rainbow. Moreover, children considered the intervention through radio very creative, and different from the educational interventions they are used to. Another positive aspect of this mode was the involvement of the family. Children reported with joy that their parents or grandparents could listen to the story with them and help them with suggestions to complete the activities of the printed script.

When children were asked about the things they had learned with the "Yellow Trials and Tribulations" story, they majorly stressed their knowledge about "planning." Participants were able to explain the meaning of this SRL strategy in their own words and provided some examples of its usage in their daily life, including doing homework or play. For example, one of the participants said "Planning is thinking before doing something, what we are going to need and what materials we are going to need, right? It is to think about what we are going to do and what objects we need" (R09). Regarding homework, participants explained that before starting doing it, they have to set aside time to complete the assignments, organize the materials needed, and plan their answers. Other participants exemplified how they applied this knowledge when playing, for example, hide-and-seek with friends: [when I play seeker] "First, I have to set a plan to find my friends. That is, I must observe what is around me, try to listen to every little noise, and then walk slowly without making noise until I find hidden spots. Then, when I find someone, I must run as fast as I can" (R07).

Other important information gathered from the interviews is related to the constraints perceived by the participants. Despite enjoying listening to the story through the radio, children reported to face a heavy workload due to school tasks, which prevented them from (fully) completing the activities suggested in the printed script. Often, participants stated, "we have a lot of homework to do; I do not have time for more tasks, I just listen to the story [through the radio]" (R03). Children's reports also mentioned the absence of teacher support to help them complete school tasks. For instance, this absence of support prevented the possibility to ask questions and for clarification of their doubts.

Moreover, the first questions of the interview script allowed to identify 18 children who did not know that the story was being broadcast by radio, and for that reason, they did not listen to the story. In fact, some parents did share with the research assistants who conducted the interviews that they believed the implementers had sent them the information previously. However, at that time, they must have missed that information, as the family was overwhelmed with work (e.g., farming, feeding the animals), information from the school, heavy workload due to extra school tasks, and laborious household management, as a result of all the family being at home. All these factors were perceived by these parents as strong barriers to their child's engagement in the project.

Finally, children were invited to provide suggestions to help children better learn the lessons of the story. The majority of the participants made the same suggestion justified with the same reason. Participants reported that it would be useful to include video calls in the program. This way, they would be able see and interact with their classmates while discussing the story, and ask questions to their teacher (i.e., implementer of the project). Other participants stated that it would be interesting to hear their classmates through the radio to learn with them.

Letters From the Colors of the Rainbow

When participants talked about their experience during the implementation of the intervention through the letters, four major categories were identified in the analysis of the interviews: positive feedback, perceived learning, constraints, and suggestions. Children said enthusiastically that the letters help them learn how to think through fun and creative activities. They added that they had really enjoyed completing the letters at home during quarantine. "Funny" was the most frequent word used by the participants to describe their experience when reading the letters and completing the activities.

When children were asked about what they have learned with the "letters of the Rainbow," the majority responded: learning about emotions, learning PLEE, especially how to plan, and finally learning to never give up. Firstly, participants mentioned to have learned a variety of emotions, regarding how they feel, as well as how others feel, particularly when someone helps them. Secondly, children were able to recall the acronym, PLEE, that was taught by one of the characters of the story: "PLEE means planning, execution, and evaluation" (L01). The children provided examples of how to use PLEE in daily activities, including school tasks. For example, "we have to make a list of all the things that we have to do during the day [Planning]; then, when we are doing them [Execution], we have to check if we are doing them as planned, which means monitoring. In the end, we have to check if we have done everything in the list [Evaluation]" (L05). Other children detailed their understanding of the planning phase. Beyond providing its definition, they gave examples specifying aspects necessary to consider during the planning phase ("...we have to think when and for how long to do each type of activity, for example, when to study and when to play [with friends] or play sports…" L16). Some participants explained the usefulness of planning: "Usually people speak without thinking before…this happens to me sometimes... I'm talking about planning, I have to think before I say something, otherwise I end up saying things that I do not want to or should not say" (L15). Finally, children reported to have learned to never give up. They recalled one of the messages of the book "those who never give up will succeed" (Character Hiccups River, p. 16),

which was sent in one of the letters (Letter 7). As one participant said, "if I want something, I have to keep doing it until I get there, and then, yes, I will get it" (L13).

Despite these positive findings, some participants reported to have read the letters, but not to have completed the activities suggested, due to the heavy workload of school tasks. This constraint was confirmed by the parents of these children at the end of the interview. Moreover, parents added that their children prioritized schoolwork. With many assignments, there was no time left for out-of-class activities, they said. In the opinion of these parents, the number of assignments already required for school was a strong barrier, and subsequently prevented their child from completing the activities.

Finally, when children were invited to provide suggestions to improve the project, the majority of the participants did not make any suggestions to improve this mode of intervention delivery. Some said, for example, "I would keep the project as it is" (L2). However, a few children reported the need for video calls to be included in the project to allow them to ask questions to the implementer.

DISCUSSION

The current work aimed to describe two offline modes of delivery of the "Yellow Trials and Tribulations" intervention during school closure due to the COVID-19 pandemic. Moreover, the potential reach of both modes, as well as participants' perspectives of their experiences during the project implementation were provided. Upon the closure of schools, and following the motto of the colors of the rainbow, "no one should be left behind," the authors were concerned with reaching as many students as possible, especially those with low digital literacy or without access to technological resources. For this reason, researchers and implementers worked together to design alternative modes of reach based on the families' needs and available resources. From this partnership resulted two modes of intervention delivery: radio broadcasting and letters.

These two modes of delivery, the materials built, as well as the prior assessment needs, were developed in a very short period of time. Authors were committed to finding alternative modes of delivery for the "Yellow Trials and Tribulations" intervention as soon as possible (i.e., the radio broadcasting mode started 8 weeks after; and the letters mode 3 weeks after school closure). These efforts were important to help prepare children to deal with the challenges of studying at home and to lessen the negative impact school closure had on students' learning and well-being.

As in any other intervention, data sets helped to evaluate the project, and consequently provide opportunity for reflection about its strengths and limitations. In the current work, data on potential reach and participants' perspectives of their experience during the project implementation will be discussed. The global potential reach of the project (radio broadcasting and letters) was 63.8%. Of these, 30% were students without access to the internet. These data indicate that about 30% of the children previously enrolled would have been left behind without these alternatives modes of delivering the intervention "Yellow Trials and Tribulations." This is a worrying figure, but it can be even higher for some of the schools enrolled (e.g., 68.2% in school 7). Globally, current findings are consistent with data from the recent survey conducted in several countries of the world reported by UNICEF (2020). Moreover, and consistent with the same UNICEF report, the percentage of students in the current work without access to internet may be underestimated. To this point, implementers collected data on students' internet connection accessibility at home, although, several factors may limit its usage, such as the number and type of devices available at home, the home workspace constraints, and the family cultural values (Moore et al., 2018; UNICEF, 2020; Xie and Yang, 2020). For example, families that declared to have internet connection access may not also have enough technological devices for the whole family, or their children may lack digital literacy. This could be the case of the children who, despite having internet connection, participated in this offline intervention (except the students from school 2, see **Table 4**). For this reason, in future interventions, implementers of the project may consider collecting more detailed information, not only about internet connection, but also of the number and type of devices available in the family. These data would have allowed the exact needs of children to be calculated (see Moore et al., 2018).

According to the UNICEF report (2020), radio broadcasting was the second most used remote learning option implemented worldwide during the pandemic, and the first option in low-income countries. Interestingly, paper-based materials were rarely used as a response during the pandemic (UNICEF, 2020). However, in the current work, the research-community collaborative team designed paper-based materials to be used in both modes of intervention delivery (i.e., session scripts and letters). This option does not require any family technological resources and may lead to a reduction in educational inequalities faced by children who are underserved or do not have the skills to use technological devices (e.g., Moore et al., 2018; Van de Werfhorst et al., 2020). Besides, extant literature indicates that paper-and-pencil assignments are as beneficial to students' academic engagement and performance as online responses (see Magalhães et al., 2020). All considered, educational stakeholders and practitioners could consider using paper-based materials as an educational response during the pandemic. Still, the authors recognize that this option was only possible due to the pre-existing strong community networks that allowed the delivery of materials to children on a weekly basis.

The interviews conducted with the children who participated in the intervention through radio and letters provided important insights about the project. In both groups, children made very positive comments regarding the continuity of the intervention in a different, creative, and funny way. The research team considers this finding very positive, because it transmits the message that despite school closure, the "Yellow" did not abandon them. Participating students could learn how to translate the SRL messages conveyed in the story-tool to life events. For example, the message conveyed: it is always possible to redefine the initial plan and execute it while overcoming obstacles. This general "take home" message is consistent with the theoretical framework grounding the intervention (see Zimmerman, 2002; Rosário et al., 2010). Moreover, during the COVID-19 confinement, it seems that particularly the letters, as they were perceived as "funny," may have helped children

to experience positive feelings (e.g., enjoyment) and well-being when completing the proposed activities at home. This is a very positive output, given that the particular context of pandemic is known to have a negative impact on the psychological state of people, including that of children (e.g., Golberstein et al., 2020; Li et al., 2020; Zhang et al., 2020).

Participants perceived learning in both modes of intervention with slight differences. Still, irrespective of the mode of delivery, students showed declarative knowledge about SRL processes and were able to provide examples of daily life applications (e.g., homework completion, playing with friends). In fact, students who master knowledge or skills in one domain are likely to apply that knowledge or skills in a different educational context (Salomon and Perkins, 1989). Findings indicated that children displayed several examples of knowledge transference (e.g., Perkins and Salomon, 2012) showing a robust domain of the SRL contents conveyed. This process of transfer of knowledge is the ultimate goal of the intervention (Rosário et al., 2010), and a hallmark of deep learning (Barnett and Ceci, 2002), because it represents the students' recognition of the relevance of those learning contents.

However, findings regarding radio broadcasting need to be interpreted with caution. As mentioned previously, implementers had conducted three to five sessions of the intervention by the time the schools closed. During these first sessions, children learned and discussed the process of planning. Thus, the current findings cannot be entirely allocated to the radio broadcasting mode of intervention delivery. Most possibly, radio broadcasting helped children recall previous knowledge. As some children reported, heavy workload prevented them from completing the activities suggested in the printed script, which may help to understand why their perceived learning was restricted to the content "planning." In fact, just listening to the story is not a sufficient condition to promote SRL skills. As previously mentioned, in every face-to-face intervention session, the reflection and discussion of the SRL strategies embedded in the chapters is structured on the three types of knowledge and follows a microanalytic methodology (Núñez et al., 2013; Rosário et al., 2017). In addition, children are expected to complete a practical activity to consolidate the SRL training conveyed (Rosário et al., 2010). These two steps of the intervention sessions encourage children to reflect deeply about and train their uses of SRL strategies (e.g., be able to select the best suited strategies to complete particular tasks or overcome difficult circumstances) (Rosário et al., 2010, 2019a). In sum, beyond declarative knowledge, children also have to manage procedural and conditional knowledge of the SRL strategies and put them into practice with proximal guidance and feedback (Schunk and Zimmerman, 1997; Rosário et al., 2010, 2016). Based on current qualitative data, children did not have these opportunities, which are key requisites of the intervention success (Rosário et al., 2017).

As the children in the radio broadcasting group, part of the children in the letters group participated in some sessions prior to school closure. Interestingly, the last group of children reported several contents learned from the letters, such as the PLEE, various emotions, and to never give up (cf. **Table 3**). The letters are not limited to these contents, but these are interesting and important gains, considering that this delivery mode does not allow group discussions as face-to-face sessions do (one of the key requisites as previously mentioned). The activities proposed in the letters may have contributed to the reported positive findings, given that children were provided the opportunity to practice SRL strategies while doing the activities suggested (e.g., Letter 11, see **Supplementary Figure 4**). Notwithstanding, the group discussions, according to the microanalytic methodology, would have promoted children's deep reflection about SRL strategies (Rosário et al., 2016, 2017). Moreover, implementers' guidance and feedback prior to children's independent practice would be essential to enhance the accuracy of the SRL competences (Schunk and Zimmerman, 1997; Quigley et al., 2018). Despite the aforementioned limitations and the modest perceived learning reported by children, the positive findings provide support to the use of paper-based materials, in this case, letters, as a useful and successful alternative mode of intervention in the context of school closure during the COVID-19 pandemic.

To strengthen the benefits of the two offline modes of intervention, it is important to consider the constraints reported by the participating children. On one hand, the high amount of school tasks overwhelmed students and families in this new circumstance of their lives (i.e., studying at home with no proximal teacher support for a long period of time). This educational scenario is likely to have prevented: (i) some students from learning that the "Yellow Trials and Tribulations" intervention was being delivered through radio, and (ii) some students from being engaged in completing the suggested activities in the printed script. For example, in the case of letters, some students reported not to have completed the activities due to this reason. As literature indicates, participants' engagement in the intervention (e.g., completing the proposed assignments) influences its impact on reported SRL strategies (e.g., Azevedo et al., 2019). Hence, educators should consider calibrating the amount of work assigned to students, especially in this case of pandemic. In this situation, educators should not assign the amount and type of schoolwork similar to that assigned in regular circumstances (e.g., Zhou et al., 2020). On the other hand, participants mentioned the absence of teacher/implementer support as another important constraint. This is consistent with literature findings which stress limited support from teachers to prevent proximal guidance and feedback, two essential keys in the promotion of students SRL development as previously reported (e.g., Schunk and Zimmerman, 1997; Quigley et al., 2018).

Finally, the suggestions mentioned by the participants, namely in the radio broadcasting group, are aligned with the last constraint. The video calls[2] would allow children to interact

[2]This suggestion indicates that part of the participating children have access to a smartphone with internet connection. This is consistent with the data reported by Moore et al. (2018) indicating that a part of disadvantaged background students has access to a single device, and this is a smartphone. Despite its limitations (e.g., single device shared by all family members with very limited internet connection), educators could consider using this resource for educational purposes whenever possible and for short periods of time given the limited internet connection through the smart phone.

with their teacher and classmates. This interaction would facilitate asking questions, discussion, and deep reflection, which are important requisites to "Yellow Trials and Tribulations" intervention success (Rosário et al., 2016, 2017); as well as the promotion of emotional engagement (e.g., Havik and Westergård, 2020). The latter is of particular importance, given that emotional engagement predicts behavioral engagement (e.g., Skinner et al., 2009). In fact, studies have shown that students who are not emotionally engaged in school tasks are prone to be behavioral and cognitive disengaged (e.g., Symonds et al., 2016; Cunha et al., 2019). The loneliness of the radio broadcasting mode of intervention and the high workload of students may have compromised students' emotional engagement, and consequently their behavioral engagement in the intervention. This emotional aspect should be taken into account in the future offline modes of intervention in efforts to help maximize its benefits.

Despite the contributions of the current work to literature and practice, there are some limitations that require acknowledgment. The study was conducted in the context of a pandemic during school closure and addressed the educational needs of students with particular characteristics (i.e., participants from deep rural areas, some with limited technological resources). These factors prevent the generalization or replication of findings. Moreover, in three of the schools enrolled, the exact number of students with access to the internet was not provided (see **Table 4**). For this reason, we may have over or underestimated the percentage of children not reached if there was no offline mode of intervention delivery offered. In addition, the research-community collaborative team did not collect data about the participants' engagement in the project, which prevents calculation of the actual reach of both modes of intervention delivery. For this reason, we are not able to provide information about the participants who were not interviewed in each mode of intervention delivery. Future research needs to address this limitation and analyze the characteristics and contextual conditions of children not reached. Despite the efforts made by the research-community collaborative team to involve students in the offline modes of intervention delivery, through interviews, it was possible to identify children not reached through radio mode. Future implementation of the project needs to overcome this limitation. Finally, it is important to acknowledge the limitation related to interviews being the sole method of data collection. However, due to the particular context of this intervention during school closure, we believe that additional data collection (e.g., questionnaires to assess SRL) would have contributed to increasing children's and their families' overload. As previously mentioned, the research-community collaborative team aimed to avoid this situation.

CONCLUSION

School closure in the context of COVID-19 pandemic brought notable challenges to children's learning with potential severe academic losses (e.g., Azevedo et al., 2020), not to mention the negative impact on their psychological state (e.g., Golberstein et al., 2020). In this scenario, SRL competences are key tools utilized to help children cope with these obstacles and adapt to the pandemic challenges (see Bandura, 2006, 2018). For this reason, the "Yellow Trials and Tribulations" intervention could not be completed by the time of school closure. Majorly, the extant educational responses are online followed by broadcast remote alternatives; however, there is data showing that more than 30% of children could not be reached throughout the pandemic through these modes (UNICEF, 2020). In this sense, it is essential to develop offline modes of intervention delivery beyond online format, in attempts to reach as many children as possible, especially, those without technological resources or with low digital literacy.

The current work focused on two offline modes of intervention delivery using radio broadcasting and letters, which may be of great interest to other contexts intending to promote SRL skills remotely. Of the 617 students enrolled in the eight schools, the offline modes of intervention delivery potentially reached about 64% of students; of these, 30% had no access to internet connection and 34% did. The two options described in the current work can also be useful to children who have technological resources and digital literacy. In fact, these modes can be an alternative, or even a complement, to help diminish excessive screen time through the computers or the use of television to support remote learning. This is a current concern due to excessive screen time with negative impacts on children's health (Vanderloo et al., 2020; Wong et al., 2020; e.g., Nagata et al., 2020). Current qualitative findings indicated that, despite some limitations (e.g., part of the children in the radio group was not reached; part of the children was not able to fully complete the activities suggested in the letters), children enjoyed the radio and letters modes of intervention delivery and were able to report what they had learned in the project: planning (radio group), learning about emotions, learning PLEE, and learning to never give up (letters group). These are positive findings, especially, in the context of the COVID-19 health emergency. In addition, data on the constraints, and suggestions are likely to help educators reflect on their practices during the pandemic, and eventually adjust them to respond to students' particular needs at this time.

To conclude, despite the challenges posed by the unexpected school closure due to the COVID-19 pandemic, the intervention "Yellow Trials and Tribulations" was implemented using different modes of delivery. Setting up this intervention was very challenging due to the constraints posed by the pandemic; still, promising positive results were found. Finally, this intervention stressed an important educational message: "no one should be left behind." In fact, despite all obstacles and hardships, it was possible to readjust the plan set for the intervention and act in accordance with the new plans. As Bandura (2018) alerts, individuals are not just products of the circumstances (in this case, the pandemic), but rather agents that may control the events affecting their lives. Hopefully, by the end of the intervention, children will be more prepared to cope with the challenges of studying at home without proximal support from their teachers, and to display efforts to mitigate the potential academic losses due to school closure.

DATA AVAILABILITY STATEMENT

The datasets generated for this article are not readily available because interview transcripts are written in Portuguese. Requests to access the datasets should be directed to prosario@psi.uminho.pt.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics committee of the University of Minho. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

JC and CS substantially contributed to the conception and the design of the paper, were responsible for the literature search, and wrote the manuscript with valuable inputs from AG, PS, CV, DL, and PR. Under PR supervision, AG, PS, CV, and DL were responsible for developing the intervention materials with community collaboration and for collecting data. CS analyzed quantitative data. JC, PS, CV, and DL analyzed qualitative data. PR was in charge of technical guidance and made important intellectual contribution in manuscript revision. All authors agreed for all aspects of the work and approved the version to be submitted.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.647708/full#supplementary-material

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Gamification as Online Teaching Strategy During COVID-19: A Mini-Review

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The ongoing pandemic caused by coronavirus disease 2019 (COVID-19) has enforced a shutdown of educative institutions of all levels, including high school and university students, and has forced educators and institutions to adapt teaching strategies in a hasty way. This work reviews the use of gamification-based teaching during the pandemic lockdown through a search in Scopus, PsycINFO, ERIC, and Semantic Scholar databases. A total of 11 papers from Chemistry, Business, Computer Science, Biology, and Medical areas have been identified and included in the present work. All of them analyzed the use of gamification strategies during the COVID-19 pandemic and assessed student's learning and motivation outcomes. In general, students reported that gamification was innovative, engaging, and an efficient strategy to deliver curricula material; moreover, it was perceived as a fun activity. Some students reported that gamified videoconferences aided to connect with their classmates during isolation time providing effective social support. However, some students reported a bad physical or psychological condition, as consequence of the confinement, and did not get involved in the activity. Some weaknesses of the reviewed studies are the small sample size and its homogeneity, which makes it difficult to generalize their results to other scenarios and academic areas. Furthermore, although there is a feeling of learning during the activity, this result is mainly based on subjective perceptions, and any of the studies demonstrated that superior learning was achieved in comparison with traditional teaching strategies. Nevertheless, gamification can be implemented together with traditional lectures and can be a valuable instrument during post-COVID times.

Keywords: gamification, videogame, simulation, COVID-19, distance learning, motivation, student satisfaction, engagement

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INTRODUCTION

In a time disrupted by coronavirus disease 2019 (COVID-19), the development of educational tools compatible with social distancing has become a fundamental strategy as millions of students are confined to reduce the spread of the epidemy. Thus, almost all teaching has quickly transitioned to distance education in order to provide appropriate social distancing (Johnson et al., 2020). Although social distancing has been accompanied by online interactions, it has been possible thanks to the continuous advances in digital technologies. Technology also gives the student much access to information and promotes the creation and sharing of knowledge, but it requires educators to

work to find ways of increasing students' motivation and engagement. Thus, a great amount of work has also been devoted to develop new teaching strategies that enhance students' motivation and commitment and maximize their knowledge acquisition. Among different strategies, gamification has attracted the interest of educators, who in the last times have been exploring its potential to improve student learning (Dichev and Dicheva, 2017; Majuri et al., 2018; Koivisto and Hamari, 2019). Studies about the effectiveness of gamification are promising, with variable to positive results (Caponetto et al., 2014; Majuri et al., 2018; Osatuyi et al., 2018; Koivisto and Hamari, 2019).

Although "game" is an ambiguous term and different game formats have been used by researchers and educators (Hanghøj, 2013), gamification can be defined as the use of game elements in non-entertainment contexts to promote learning. The fact that games have many elements that are naturally appealing for young and adults and have a strong influence in their lifestyle helps to introduce an extra motivation for learning. Over the last decade, gamification is being increasingly employed in learning environments as a way to enhance students' motivation and encourage social interaction. Thus, games have been employed in many educational contexts across different educational levels, showing its potential to improve learning outcomes (Seaborn and Fels, 2015; Koivisto and Hamari, 2019). The symbiosis between gaming and learning is also evidenced by the progressive development of best practices for courses gamification and game design. Usually, the game (course) is designed to progressively introduce new concepts to be mastered; students must then apply these concepts to increasingly challenging problems and ultimately apply prior knowledge to new situations (Varonis and Varonis, 2015). Another reason for including game elements in education is that it has been reported that games can provide social links (Waytz and Gray, 2018), promote knowledge seeking (Toh and Kirschner, 2020), develop creativity (Vartanian and Beatty, 2015), improve mental health (Cruea, 2020), and reduce isolation (Valkenburg and Peter, 2009).

There exist several types of games and gamification strategies. Quizzes are one of the simplest ways to gamify teaching, allowing students to test their knowledge on different platforms, such as web-based quizzes or apps. In recent years, educators have developed thousands of electronic quizzes as apps to assist students in many areas. Additionally, different strategies have been employed: the challenge-, the immersion-, and the social-based gamification. The first strategy is based on overcoming challenges (Majuri et al., 2018; Koivisto and Hamari, 2019). The second model attempts to immerse the user into a story and is characterized by its audiovisual richness (Concannon et al., 2019). Finally, social-based games permit to develop strategies of competition and collaboration (Romero, 2017).

Gamified activities have been linked to enhancing students' intrinsic and extrinsic motivation. In this line, the self-determination theory places the focus on three basic psychological needs: autonomy, relatedness, and competence (Richter et al., 2015). Thus, gamification must fulfill at least one of them. Another theory that has been associated with gamification is the goal-setting theory. According to this theory, there are four factors linked to students' performance: their commitment toward the goal, the feedback they receive, the complexity of the activity, and the situational constraints (Locke and Latham, 2002, 2006; Landers, 2014). According to this theory, gamification would require a challenge, an indication of progress, some feedback, levels of achievement, and a sort of competition (Huang and Hew, 2018). The third theory related to gamification is flow theory, where an optimal psychological and physical state maximizes enjoyment and engagement. According to this theory, gamification requires specific and understandable goals, immediate feedback, achievement indicators, and an adequate balance between challenges, student's skills, and perceived value of the activity (Huang and Hew, 2018).

Thus, according to the goal-setting and flow theories, besides designing applications with capability to increase students' motivation, teachers must also consider the special difficulties that their students face during confinement. Therefore, they can use gamification to mitigate physical and psychological constraints associated with a situation of quarantine. Furthermore, not all students have high-tech devices or appropriate internet connection at home, which restrict the generalized adoption of gamification for distance learning situations, as has been observed during the COVID-19 pandemic, particularly in developing countries and rural areas.

This work is aimed at reviewing the published experiences of gamified learning in secondary school and university education during the COVID-19 pandemic. We will describe the gamification strategy, the methodologies used during the COVID-19 pandemic, and its motivational and educational outcomes. Finally, we also pretend to analyze the theoretical base of these gamification strategies and how they have helped to ameliorate the situation of the students from a physical and psychological situation.

GAMIFICATION CASE STUDIES IN COVID-19 TIMES

Although there exists previous evidence about the use of online tools and games in education, the number of studies using gamified strategies during the COVID-19 pandemic is scarce. There are, however, a large number of publications describing research proposals, protocols, and expert opinions regarding the implementation of digital tools in education. The sudden development of the COVID-19 outbreak made it difficult to plan empirical studies that tested the use of gamified tools, with the majority of educators doing huge efforts to move from a face-to-face classroom environment to online lectures through videoconferencing tools.

In the present work, a non-systematic search for terms included in the title, abstract, or keywords using the following syntax [("distance" OR "remote") AND ("teaching" OR "learning" OR "education") AND ("covid" OR "pandemic") AND "gam*"] has been carried out. The search was done on February 28, 2021 for studies published between January 2020 and February 2021 in Scopus (46 results), PsycINFO (2 results), ERIC (1 result), and Semantic Scholar (1,450 results) databases.

Only research articles and conference papers describing a gamified practice in a learning environment have been included. Studies not written in English, reviews, surveys, and opinion papers that did not carry out any gamified practice have been excluded. A total of 11 studies that met these eligibility criteria have been included and reviewed here. The studies reviewed correspond to the following areas of knowledge: Chemistry, Business, Computer Science, Biology, and Medical education. A summary of the reviewed studies is shown in **Table 1**.

Chemistry Learning

Organic Chemistry is considered a difficult subject for secondary school and undergraduate students, being organic reactions are one of the most difficult topics in Organic Chemistry (Eticha and Ochonogor, 2015). Previous studies show that when learning activities of chemistry concepts are combined with games in the classroom, students' motivation increases (Stringfield and Kramer, 2014) improving their performance (Liberatore, 2011; Revell, 2014) and making them more engaged compared with traditional methodologies (Sousa Lima et al., 2019; da Silva et al., 2020b).

da Silva et al. (2020a) designed an interactive game-based application (Interactions 500) aimed to help students review concepts related to intermolecular forces in a collaborative environment. This game was originally designed to be used by students in the classroom; however, the interruption of face-to-face classes due to the COVID-19 pandemic required to use it remotely. Forty-four pharmacy undergraduate students (11 groups) played the game remotely. A student got the role of a leader who was in charge of coordinating the game, motivating their mates, discussing answers, and clarifying doubts. In the game, there was a competition among students who had to answer different quiz questions. The students rated the game very positively through a Likert-type survey with regard to its design, content, game play, and usefulness as educational tool. The authors compared the knowledge of a group of 44 students who played the game with regard to another group (N = 40) who were not exposed to it and studied alone at home. Both groups showed similar marks in the pretest and the post-test and the same level of learning. Therefore, the authors concluded that the game resulted in similar learning outcomes to traditional problem-solving classes, although only the game created a pleasant learning environment, so all the students who played the game reported that they preferred it with regard to regular problem-solving classes.

Fontana (2020) developed a gamified activity based on ChemDraw (a software designed for drawing molecules) with the aim of making students get practice using this tool. Thus, students had to compete in a tournament. The idea was that it would maintain the classroom community, improve students' wellness, and develop their organic chemistry skills. Videoconferencing software (Zoom) was used to enable real-time classroom participation. Nine students participated in the molecule speed-drawing tournament (Molecule Madness). A molecule's chemical structure was posted to the class learning platform, and for each match, two students had to share their screens with the class and compete to correctly draw its structure first in ChemDraw. Non-participating students followed the tournament as active observers (social spectators), socially engaging with fellow observers and learning from contenders. Students competed to correctly draw molecular chemical structure, where advanced rounds presented molecules progressively more difficult to draw. By playing ChemDraw, students reported wellness experiences comparable with playing traditional videogames: enjoyed practicing, felt expectancy for the coming class activity, and connected with their classmates. They also described Molecule Madness as a fun way to learn organic chemistry, practice ChemDraw, and promote high levels of excitement and engagement. According to the author, postpandemic chemistry education will likely include some distance gaming elements that will enhance face-to-face teaching.

Chemistry crosswords have been used for a long time, and their effectiveness has been described as a tool for leaning during the COVID-19 pandemic. Pearson (2020) used crossword puzzles as a model of remote active learning for first- and second-year undergraduate pharmacy students. Chemistry-themed crossword puzzles were delivered *via* the eBlackboard site and used to supplement lectures and problems content. This activity started before the lockdown, so the author compared students' behavior before and during the lockdown, with no clear differences between both periods. When analyzing students' exam performance with and without crossword aids, no significant differences were observed in the mean and median cohort exam grades (compared with a cohort from the previous academic year). However, more students responded to the question (from a choice of four) taught alongside online crossword exercises. The author suggested that the crossword activity instilled greater confidence to answer a question when it had been included in the crossword exercises. Moreover, a larger percentage of students got higher marks in their exam after crossword exposure compared with the previous academic year, in the absence of the crosswords. The author suggested that the crossword impacted the exam performance for at least more engaged students. Around 50% of first-year students and 80% of second-year students reported that this activity was helpful and would welcome more. Moreover, in an online survey, 20.4% of the students rated quizzes and puzzles as the best remote teaching tool second only to instructional videos (46.3%).

The author proposed that, looking ahead, these puzzles should be delivered in a more interactive online format and provide instant feedback. Moreover, for optimum student engagement and learning improvement, instructors could design crosswords that help students identify key topics and concepts. Finally, another approach would be that the students create their own crosswords.

The COVID-19 pandemic learning disruption has seriously affected interactive and hands-on experiences in laboratories. Thus, D'Angelo (2020) developed a series of five exercises, called "Labventures," mimicking the principle of "Choose your own adventure" books or escape rooms. The exercises were created to review/reinforce several tasks, and 24 students took part. Labventures stories were set up as a series of webpages, and the students should complete a laboratory task choosing proper techniques. After every incorrect response, the students

TABLE 1 | Articles included in the review: objectives, methodology, and outcomes.

Article	Gamification objectives	Game elements	Data collection	Motivational outcomes	Learning results
da Silva et al. (2020a)	To help students review concepts in a collaborative environment	Competition, cooperation, challenge, points, and leaderboard	Exam scores, student feedback through questionnaires	Increased motivation through competition for leaderboard rank	Learning improves in the same way as regular problem-solving classes
Fontana (2020)	To maintain students' wellness and class community and to develop knowledge	Competition, points, and videoconference	Student feedback through surveys, observation of students' behavior	Increased engagement, improved class morale, and enthusiasm	Subjective perception of learning
Pearson (2020)	To provide a remote revision aid tool	Puzzle (no immediate feedback	Student-tracking statistics, cohort exam scores, and student feedback questionnaire	Increased confidence and increased engagement in some students	Higher percentage of students scoring over 75 and 87.5%
D'Angelo (2020)	To reinforce laboratory topics and to engage students	Escape room-based procedure	Student-tracking statistics	No real engagement	Bad performance in general
Pakinee and Puritat (2021)	To motivate and engage students	Avatars, challenges, points, levels, progress, and leaderboards	Pre–post-exam, student-tracking statistics, and interviews	Higher engagement but short lasting	No differences between gamified and non-gamified groups
Lelli et al. (2020)	To motivate and engage students and to review and practice theoretical knowledge	Avatars, points, levels, and missions	Tasks scores, forum comments, questionnaire responses, list resolution, quiz, and participation in debates	Remote activities were not mandatory and participation was lower than expected	Subjective and variable perception of learning in a reduced number of participants
Liénardy and Donnet (2020)	Theory concepts reminder	GameBook	Exercises performance	Low participation	Not assessed
Lobet et al. (2020)	To learn biological vocabulary and to enhance motivation	Treasure hunt, photo quiz	Picture collection and photo quiz accuracy, student feedback survey	Higher engagement in hunt than in photo quiz activity	Feeling of having learned. Lower accuracy in photo quiz
O'Connell et al. (2020)	To review of core obstetrics and gynecology topics	Imaging quiz, points, and competition	Responses to quiz questions, assessment of proposal for case management, and post-session survey	95% showed engagement	High feeling of having learned
Kobner et al. (2020)	Development of clinical reasoning skills and to improve engagement	Serial cues, simulation, dice, and videoconference	Semi-structured interviews	Increased engagement	Feeling of improved clinical reasoning abilities
Patel et al. (2020)	To enhance medical knowledge	Simulation, videoconference	Pre- and post-test, and final survey	Limited engagement due to larger group size	Statistically significant knowledge gain

were given feedback explaining why a choice was wrong, whereas correct choices moved the activity forward. However, the analysis of students' execution indicated a low performance and understanding of the activities. The author proposed some improvements for future versions of these exercises, including pictures or videos, providing more data to encourage problem solving, using a notebook quiz, and giving further information after wrong choices.

In all the works, a small number of participants with reduced heterogeneity of the samples were included. In the case of da Silva et al. (2021), 44 pharmacy undergraduate students were included. In the studies done by D'Angelo (2020) and Fontana (2020), all the students belonged to the same classroom, whereas 132 first-year and 120 second-year undergraduate pharmacy students participated in the study of Pearson (2020). Nevertheless, the main weakness comes from the predominant use of subjective procedures to assess learning outcomes.

Business Studies

Pakinee and Puritat (2021) investigated the effect of gamified and non-gamified learning for an Enterprise Resource Planning (ERP) course to motivate the students to engage and participate during working from home. Thus, two versions of an e-learning platform were developed, one implementing game elements (avatars, challenges, levels, points, progress bar, and leaderboard) and another one without game features (just the exams and course materials). Furthermore, in their study, the authors considered students' personality traits (Extraversion, Neuroticism, Conscientiousness, Agreeableness, and Imagination/Openness). A test before and after each chapter and web monitoring of students' activity provided quantitative data about their performance. According to the results, the gamified e-learning group showed higher engagement during the first 2 weeks, but then it started to drop, and at the fourth week, both groups had equaled their activity. The authors referred that the gamification strategy increased students' activity in the short term but not in the long term. Another activity record showed that gamification motivated students to start working during the first days a lesson was available, whereas the non-gamified group delayed their activity to the end of the week. Nevertheless, there was no statistical evidence to support any differences in learning between the non-gamified and gamified groups.

According to the authors, gamification cannot improve the overall knowledge because it has positive and negative impacts on each personality type. Thus, some personality traits were linked to higher scores for the gamified e-learning because they are more prone to competition, whereas others reported a negative effect from competition. The authors affirmed that gamification in the ERP course can improve students' motivation, although the fun and curiousness related to gamification are short-lived. They recommend adding new small tasks of game elements every 2–3 weeks until the end of the course, concluding that gamification of e-learning alone serves as a tool to engage students in distance learning, but in order to enhance learning, the presence of a lecturer is also required.

This work has the merit of including students' personality traits as a research variable. Thus, it can provide some cues about how to design more personalized gamification strategies according to participant's personality. Furthermore, it has compared the efficiency of gamified and non-gamified options. However, it has some limitations, for instance, the research was conducted only in one course (ERP) and the limited number of participants per group.

Computer Science Learning

Lelli et al. (2020) addressed the concept of Emergency Remote Teaching (ERT) as a temporary shift of teaching in crisis circumstances and involves the use of fully remote teaching solutions. The authors described a gamification methodology for two Computer Science courses by using ClassCraft, a free educational platform from Google that works as a virtual classroom. This platform allows the teacher to assign tasks to the students and enables the use of asynchronous (forums, videos) and synchronous tools (chats) and a score based on the accomplishment of the tasks. A number of modules (missions) with different tasks were defined according to the courses content, and game levels for each module were set as students progressed through tasks.

The authors stated that the use of this gamification tool was effective to engage the students during the pandemic. Some students pointed out gamification as a positive experience to learn remotely. However, the number of students who participated in the remote activities decreased after some time, with some students reporting no physical and psychological conditions or interest in following the gamification activities. The authors also observed that students had difficulties to understand the purpose of using asynchronous tools, such as forums.

In another work, Liénardy and Donnet (2020) provided to first-year Computer Science students a set of gamified homework exercises, they called GameCode, aimed at teaching an appropriate methodology for programming. The exercises were inspired by GameBooks in which the reader can choose the path to complete the story. Students could choose their own solving path for each exercise and do it at their own pace. Any GameCode exercise met the following requirements: (a) each exercise was self-sufficient and contained the minimal information to complete it; (b) theoretical reminders were needed and were as short as possible; (c) hints never revealed the solution, nor a part of it; and (d) several solutions were always possible and could be discussed in the course forum. However, the authors reported that few students took part in the exercises, as many students had abandoned their courses, supposedly a consequence of the loss of motivation by the COVID-19 lockdown. Half of students who did the activity informed that they liked it, but 43% declared that they would have preferred podcasts.

In both studies, the reduced number of participants can be considered a serious weakness. In the study by Lelli et al. (2020), the use of a free platform will allow other researchers to replicate the same protocol in different courses. However, in both cases, the participation was lower than expected, which demonstrates a lack of motivation and engagement. Similar outcomes were obtained by Liénardy and Donnet (2020). In both cases, the authors explained the low participation as a consequence of the physical and psychological effects of COVID-19 confinement.

Biology Studies

Teaching biology is particularly challenging if the students are not allowed to access laboratories for hands-on observation of fresh specimens and the lockdown restricted movement outside students' home. Lobet et al. (2020) developed a biological treasure hunt activity for 346 first-year biology students by using QuoVidi, an open-source web-based platform. This platform was conceived to teach biological vocabulary and to observe the surrounding natural world. Students received a list of quests that addressed botanical and zoological terms. Students should understand the meaning of the quest and go out to get photos of plants and animals that should be uploaded to the platform. Due to movement limitations during the lockdown, there was the option of learning from photos submitted by other students (photography quiz). In this case, they had to match the submitted photos with their quest. Students showed a good performance as the majority of pictures submitted in the treasure hunt activity were correct. Nevertheless, performance was less accurate for the photography quiz, probably due to different levels of engagement. Regarding students' feedback, 91% reported to like the activity and have learned from it, although there were two main criticisms, that the activity took so much time and some students had the feeling that they did not truly learn. The authors addressed these points by proposing a better tailoring of the activity and a better communication with the students about the pedagogical goal of the activity.

One strong point of this activity is its scalability, so hundreds of students can be involved. Furthermore, according to students' feedback and performance, it was motivating and engaging in learning a list of technical vocabulary. Nevertheless, the photography quiz, included as a response to the lockdown, resulted in a worse performance compared with the hunting activity. Thus, it would be essential to redesign the photography quiz in order to make it more engaging and efficient.

Medical Education

COVID-19 has challenged medical educators on continuing to provide quality educational content. O'Connell et al. (2020) described a novel virtual game for obstetrics and gynecology teaching. The game consisted of several rounds of rapid-fire questions and cases, eliminating teams to a final contest. All residents participated individually in a previous "warm-up" round, using a Kahoot quiz to test their knowledge of ultrasound imaging. The residents were divided into small groups and placed into a breakout room with a faculty facilitator who then divided their residents into two teams of three to four residents. The two teams then competed in the breakout room for the first three rounds. Each round focused on testing the team's knowledge of a different aspect of obstetric and gynecological care. The fourth and final round was a series of three cases in which the remaining teams were given a case and they had to write down their proposal for how each case should be managed. The fourth round was judged by the faculty facilitators. At the end of the game, 23 out of the 36 residents completed an anonymous online survey. A large majority of the residents enjoyed the activity. Ninety-five percent of the residents were in agreement or strong agreement that they were engaged during the activity. Seventy-four percent were in agreement or strongly agreed that this activity was better than traditional lectures. Therefore, the majority of the residents found this activity to be educational, entertaining, engaging, and better than the traditional lecture format.

Medical students usually learn clinical reasoning through "whole-case" conferences. However, this procedure has many challenges in social distancing scenarios. Thus, although videoconferencing tools allow some interaction, audience engagement and active participation are limited. Kobner et al. (2020) have described a novel case conference format to train clinical reasoning skills to a spatially distant audience. In their work, the authors describe a gamified serial-cue, low fidelity simulation in which a team of residents must analyze a real case that challenges their clinical reasoning skills. The case includes all relevant diagnostic results, including several elements that challenge clinical reasoning abilities. The team of residents plays through a simulated tabletop version of the case live on a videoconference call. The case flow is facilitated by a chief resident familiar with serial-cue tabletop simulations and gaming procedures. A simulated cardiac monitor provides vital signs to the team and the virtual audience, and as team members ask for diagnostic studies, the facilitator provides them through Dropbox to the team and the audience. At the conclusion of the case, a debriefing was conducted. After this, a spontaneous discussion ensued, covering themes ranging from diagnostic decision to patient safety and foundational medical knowledge. Finally, a sample of simulation participants, the virtual audience, and residency program administrators were interviewed. All simulation participants felt that the tabletop simulation improved their clinical reasoning abilities in ways that mimicked real clinical encounters. They reported that the level of unpredictability helped to model the actual practice of emergency medicine, adding a level of excitement absent from typical mock oral boards-type tabletop simulations. Audience members agreed that they were more engaged throughout the case simulation than during traditional case conferences. Residency program administrators noted increased faculty engagement and discussion when compared with traditional case conferences. Finally, interviewees suggested that this experience would benefit from more gamification throughout the simulation.

Telesimulation can be employed to deliver hands-on training that usually takes place in in-person simulation. In order to assess if it can be effective to teach anesthesiology trainees to manage a complex case-based scenario, Patel et al. (2020) developed a remote high-fidelity immersive case-based scenario for anesthesiology residents training. For this, the authors adapted an existing simulation scenario based on a real clinical case. Fifty-eight residents were scheduled to participate remotely *via* Zoom meetings. For each session, a group of 6–8 residents participated in the simulation (a total of 8 sessions were carried out), whereas 4 faculty anesthesiologists were present in the simulated operating room with a manikin. Using Zoom's share screen feature, images of the operating room and a manikin vital signs were monitored. The residents were asked to respond to the scenario and verbalize all the actions that they would perform in a real-life situation. An anesthesiologist present in the operating

room performed actions based only on instructions from the residents' team. Just before and after the simulation, participants' medical knowledge was assessed through an online exam, and a satisfaction survey was conducted at the end of the activity.

Overall, telesimulation resulted to be effective at increasing residents' knowledge as their score was superior in the post-test. They also rated the experience positively and informed that it could be a reasonable substitute for in-person learning. Nevertheless, the authors pointed out the importance of using small group sizes (3–5 students are the typical number for traditional simulations), assigning roles to participants, and using intermittent reflective pauses.

The main weakness of these studies is the small number of participants, and that they are based on a single-center study. Moreover, only students' attitude was evaluated in O'Connell et al. (2020) and Kobner et al. (2020), and there are no results about the educational efficacy of the activity. Patel et al. (2020) conducted pre- and post-assessment of residents' medical knowledge; however, there was no comparison for knowledge gains in telesimulation versus traditional simulation setups.

CONCLUSION

In recent years, several innovations have emerged in the field of education. In an age disrupted by COVID-19, the development of gamified teaching strategies can be seen as a promising option to provide knowledge and enhance students' collaboration during social distancing. Thus, although traditional scholarly academic curricula are content-focused and essentially ignore personal development, some gamification literature suggests that collaborative activities can stimulate motivation and enhance learning (Rutledge et al., 2018). All the studies described here aimed at enhancing learning by improving participants' motivation and engagement. Some studies have used a pre-existing platform that has been gamified, but there are also some experiences in which a gamified application has been developed on purpose by the authors. In most of the cases, the gamified activity was well-received by learners, considered effective, educational, and engaging, and in some cases also fun.

One of the findings of this review is that most of the gamification experiences have been developed in Science, Technology, Engineering, and Mathematics (STEM) disciplines. This could be the consequence of the difficulties to carry out laboratory and hands-on practices during the COVID-19 pandemic, which particularly have affected these fields. Nevertheless, the efforts to introduce teaching innovations that help to overcome social distancing shortcomings have led teachers to improvise activities along the way. In many cases, this has been associated with a poor planning of the gamified environment, together with the *ad hoc* use of gaming elements mechanics with unclear guidelines for students. Thus, some of the studies included in the review (D'Angelo, 2020; Lelli et al., 2020; Liénardy and Donnet, 2020) showed little or no participation by students. According to the authors, such apathy would be associated with a decreased intrinsic motivation related to the pandemic situation. At least in these cases, the employed gamification strategy did not result in efficient tool for engaging students.

Although any of the reviewed studies have implemented a theoretical framework behind their gamification strategy, most of them have reported an increase of learning and/or motivation. Game elements associated with competition, such as leaderboards and points, have been the most common ones, resulting in higher levels of engagement and learning outcomes, with similar results being reported in simulation procedures and quizzes. Only one study used puzzles, reporting moderate results, whereas those that employed escape rooms and gamebooks resulted in negative outcomes.

It has been stated that competition elements affect extrinsic motivation in students mainly, without increasing intrinsic motivation (Erdogdu and Karatas, 2016). However, most of the reviewed studies have reported a sense of enjoyment and positive feelings toward learning, which are directly related to intrinsic motivation (Bai et al., 2020). Thus, all the reviewed studies that reported positive emotions associated with intrinsic motivation, even when external elements were employed (competition elements), referred to increased motivation, engagement, and/or learning outcomes. Thus, intrinsic and extrinsic motivation would correlate and show common properties as stated by the Self-Determination Theory (Ryan and Deci, 2002). However, some studies (D'Angelo, 2020; Lelli et al., 2020; Liénardy and Donnet, 2020) reported low motivation, engagement, and/or bad performance. In order to increase the interest and motivation of students, they should receive continuous support from the teaching staff, and the aim of the activity should be clear for all them.

Gamification procedures allowed to monitor students learning progress in a non-invasive way, for instance, tracking students' behavior in the web platform, or their achievements in the game. Other strategies to gather information about students' perception of their own progress relied on the use of questionnaires and interviews. However, some works have attempted to assess students' learning through their performance in exams. In general, the reviewed studies have combined quantitative and mixed methods to assess students' learning and engagement (see **Table 1**). In general, most of the reviewed works came to the conclusion that gamification resulted in learning outcomes. In some cases, this statement was a subjective perception of participants obtained through questionnaires, whereas other works performed objective tests to assess students' knowledge. For instance, da Silva et al. (2020a), Pakinee and Puritat (2021), and Patel et al. (2020) compared students' performance in pre- and post-exams, whereas Pearson (2020) compared exam scores with regard to previous year scores, showing an increase of students' knowledge following gamified activities. However, there is no evidence indicating that gamification yields better learning outcomes than could be obtained with more traditional strategies. Furthermore, one study (Pakinee and Puritat, 2021) reported that gaming elements linked to competition resulted in controversy and did not produce the same effect in all students, and in some cases, they could increase or decrease motivation according to the student's personality.

Social interaction is considered one of the foundations of gamification (Sánchez-Martín et al., 2017). All the studies were conducted in a time of limited social interaction; however, only Fontana (2020) had as a main goal to enhance students' well-being and promote social interaction. The author reported an increase of class community, showing that the gamification strategy was useful to keep class morale during social distancing time.

According to the works reviewed, it is possible to infer that gamification can be effectively combined with traditional teaching methods, such as online lectures, in order to enhance students' engagement and deliver curricula material that usually is taught through face-to-face education. Likely, technology-enhanced learning initiatives will become more prominent as the education landscape is reorganized following COVID-19, and gamification may therefore be considered as an option to augment traditional learning no longer deliverable at traditional face-to-face classes. It can be also incorporated into academic programs currently limited to videoconference lectures to boost students' engagement and motivation.

There are, however, some weaknesses that must be taken into account. The reviewed studies are mainly a single-center study with data from single classroom groups, resulting in a relatively low number of participants, which restricts the generalization of their results. Furthermore, all studies included had a short-term format. Thus, longitudinal studies are required to determine the efficacy of gamification as teaching strategy. Nevertheless, the main limitations are the lack of an objective assessment of learning as result of the gamified activity and the lack of a theoretical framework. Although some studies (Lobet et al., 2020; Patel et al., 2020) reported that the students' knowledge improved after the activity, there was no direct comparison with conventional teaching scenarios. Only Pakinee and Puritat (2021) compared the performance of their students in both situations, showing that gamification made students start working earlier, but there were no differences on their performance in the long term. This could indicate that gamification can open a more efficient time window during online learning. Therefore, the main conclusions of the reviewed studies are based on the subjective perception from participants: "a fun way to learn" or "feeling to have learned." In some cases, this drawback resulted from the sudden lockdown imposed by the authorities, so teachers had to design and adapt their courses along the way.

We must remark that during the COVID-19 lockdown, many students faced increased demands at home, many had to bring together their studies with their job activities, caring for children during the day, along with an increase of academic online activities. Furthermore, some students and teachers could be resistant to implement a game as an educational tool as it is a new way of learning and teaching quite different from the traditional classes. It is also important that there is a good communication between teachers and students, so the pedagogical aim of the activity becomes clear.

Finally, it is important to bear in mind that there are many examples of trendy "gamechangers" in education that have varied greatly over time. Problem-based learning, for instance, once a main educational strategy in some curricula, and social media-based learning have lost part of their interest after a time of apogee (Guckian and Spencer, 2018). It is essential that educational innovations have a solid foundation on research data. In the case of gamification as an educational strategy, future research must address different aspects, such as game mechanics and elements, in relation to an underlying theoretical framework.

AUTHOR CONTRIBUTIONS

FN-E and MR-T conceived the present work, did the literature search, wrote the manuscript, and revised and verified the final version. Both authors have read and accepted the content of the manuscript.

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Psychoeducational Challenges in Spanish Children With Dyslexia and Their Parents' Stress During the COVID-19 Pandemic

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Background: Research during 2020 has been rapidly attending to the impact of COVID-19 on various dimensions of wellbeing (e.g., physical, psychological, lifestyle and routines) on adults and children around the world. However, less attention has focused on the psychoeducational impact on children and their families. To our knowledge, no currently available studies have looked specifically at the impact of COVID-19 on students with dyslexia and their families. Research on this topic is needed to offer greater support for this population of students and their families.

Objective: The main objective of this paper is to examine the psychoeducational impact of the required COVID-19 quarantine in Spain among children with dyslexia and their families.

Method: A sample of 32 children with dyslexia and their mothers participated in this study.

Measures: Children and adolescents with dyslexia and their mother completed several measures before the required national quarantine in Spain and again during the quarantine. Children completed measures of depression, state anxiety, reading activity, and reading motivation. Mothers provided demographic information and completed measures related to students' emotional and behavioral difficulties as well as parenting stress, parental distress, and a questionnaire about educational problems during quarantine.

Results: Major findings showed that during quarantine, children with dyslexia had increased levels of depression and anxiety symptoms, and parents perceived their children as having more emotional symptoms, hyperactivity-inattention, and conduct problems. During quarantine, children and adolescents with dyslexia also showed less reading activity and less reading motivation. Parents also reported significantly more stress, during quarantine compared to pre-quarantine conditions. Some demographic and psychological variables predicted children's state anxiety as well parental stress. The questionnaire related to impacts of quarantine also revealed several important findings. For example, nearly all parents of children with dyslexia reported (a) difficulties

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in establishing study routines, (b) that the quarantine negatively affected their child's learning, and (c) that they did not receive sufficient help from teachers on how to support their child's learning. Additionally, the vast majority of the parents were very worried about the child's learning and school success, the child's motivation and interest in reading, the child's peer relations, and the professional skills of the child's teacher.

Conclusion: This study offers a preliminary investigation into this topic and elucidates several psychoeducational challenges that children with dyslexia and their families have experienced during the quarantine in Spain. Study findings highlight the need to provide immediate support for children with dyslexia and emphasizes the importance of developing prevention programs to mitigate any future negative impacts of COVID-19 on children with dyslexia and their parents.

Keywords: dyslexia, COVID-19, psychoeducational impact, parent stress, quarantine

INTRODUCTION

Dyslexia is a neurodevelopmental disorder of neurological origin and characterized by impaired reading acquisition despite the presence of adequate intelligence, education, and socioeconomic background to learn to read (American Psychiatric Association [APA], 2014; Adrián-Ventura et al., 2020). Dyslexia impacts approximately 6% of elementary and secondary students in Spain (Jiménez et al., 2009; González et al., 2010) and an estimated 5–15% of the global population (American Psychiatric Association [APA], 2014). The first decades of research in dyslexia were mainly devoted to the cognitive and biological underpinning of the disorder (Vellutino et al., 2004; Soriano-Ferrer and Piedra-Martínez, 2017). Compared to students with average to above average reading skills, accumulated evidence suggests that students with dyslexia can show a range of reading-related (e.g., pseudoword reading, spelling, vocabulary) and cognitive (e.g., rapid naming, verbal, working memory) difficulties (Soriano-Ferrer and Miranda, 2010; Kudo et al., 2015; Soriano-Ferrer et al., 2016; Morte-Soriano et al., 2020).

In recent years, a growing body of evidence suggests that children and adolescents with dyslexia also show increased risk of experiencing mental health difficulties (Swanson and Vaughn, 2016; Heiman and Olenik-Shemesh, 2020). The repeated experiences of failure faced by students with dyslexia appear to increase their vulnerability to experiencing internalized disorders (e.g., anxiety and depression) and lower opinions of their academic competence. Studies examining psychological wellbeing for those with a learning disability (LD) offer relevant data because dyslexia is the most common LD. For instance, the meta-analysis by Nelson and Harwood (2011b) revealed that around 70% of students with a LD experience greater anxiety symptoms than students without a LD, and there were no differences between self-reports and parent reports of anxiety. Also, a study by Panicker and Chelliah (2016) revealed that a relatively higher percentage of students with a specific LD had severe stress (16%), severe anxiety (23%), and/or severe depression (14%). Nelson and Harwood (2011a) also completed a meta-analysis to understand depression among students with a LD and found higher scores on measures of depression than students' peers without a LD, which was true regardless of who reported depression-related symptoms (i.e., self-report, parent, or teacher). Similarly, the meta-analysis by Francis et al. (2019) found that poor readers were at moderate risk (at statistically significant levels) for experiencing anxiety and depression, and Mammarella et al. (2016) found that students with dyslexia have worse symptoms of depression than individuals with non-verbal learning disabilities.

Some studies (e.g., Lee and Zentall, 2012; Soriano-Ferrer et al., 2014; Wolters et al., 2014; Soriano-Ferrer and Morte-Soriano, 2017) have also looked specifically at the psychoeducational wellbeing of children with dyslexia and found that this population of students have more negative self-perceptions as readers (e.g., feeling less competent in reading, having more difficulty, and not liking reading), have lower motivation to read (e.g., they more commonly avoid reading activities) as assessed by self-reports or by teachers' reports, and demonstrate lower utility of reading. Thus, students with dyslexia read less for enjoyment and engage less in reading activities. Lee and Zentall (2017) also found that students with dyslexia maintained low reading motivation and decreased their reading for school as they transitioned to middle school.

Dyslexia presents significant challenges for the student and it can also have negative impacts on their parents (Delany, 2017). Mothers, in particular, show higher levels of stress and depression and report significant impacts on family and increased difficulties in everyday life (Bonifacci et al., 2014). Snowling et al. (2007) observed that approximately 74% of parents reported that their child's difficulties had a mild to severe impact on family life and that mothers of children with dyslexia had higher levels of stress and depression. Using the Parental Stress Index (PSI), results of Bonifacci et al. (2014) seem to suggest that the effect on the family system of having a child with dyslexia may be specific to parent-child interactions and on worries regarding the needs of the child with a LD. Also, Carotenuto et al. (2017) found that mothers of children affected by dyslexia reported higher rates of parental stress and difficulty on the PSI according to indexes of Parental Distress, Parent-child Dysfunctional Interaction, and "Difficult Child" (which measures a parent's perceptions of the child's

behavior with respect to behaviors that often make parenting easier or more difficult.

COVID-19 and the Impact of National Quarantines on Children and Their Families

Because of the significant and widespread health threat of the coronavirus (COVID-19) pandemic, many governments worldwide decreed home-based quarantines as an approach to contain the expansion of COVID-19. For example, Spain was in state of alarm from March 14, 2020, until June 21, 2020, with few exceptions (e.g., to purchase essential items such as food, attend health centers, or take a walk close to home). According to the United Nations Educational, Scientific, and Cultural Organization [UNESCO], 2020), school closures caused by the coronavirus pandemic have already affected over 1.5 billion students and their families. The disruption of in-person learning is unprecedented and, as was highlighted in the report of Di Pietro et al. (2020), the move to remote learning environments in numerous countries could have significant and negative impacts on children's academic learning as well as their cognitive and non-cognitive skills.

School closures–and therefore remote learning–creates restricted mobility and social isolation for students and the overall set of circumstances presents major challenges for children and their families' psychological wellbeing (Cachón-Zagalaz et al., 2020; Griffith, 2020; Mazza et al., 2020a,b). Several recent studies have used parent reports about the impact of quarantine on childrens' or adolescents' mental health. For instance, with a sample from Spain, Erades and Morales (2020) found that 70% of parents reported their children as having at least one negative emotional reaction during the pandemic (e.g., 31% were reported to have sleep problems and 24% had behavioral problems). Gómez-Becerra et al. (2020) indicated that the highest psychological difficulties for Spanish children and adolescents appear to be connected to emotional symptoms, behavioral problems, and overall difficulty. The authors also reported that as the quarantine continues over time, the presence of psychological difficulties generally increase. Within western countries, emotional and behavioral changes in their children were observed by parents in the first weeks of lockdown (Francisco et al., 2020; Orgilés et al., 2020). For example, in the study by Orgilés et al. (2020), 86% of parents from Spain perceived changes in their children's emotional state and behavior during the quarantine (e.g., 77% had difficulty concentrating, 52% experienced significant boredom, 39% experienced irritability, 38% showed restlessness, and 38% had notable nervousness). In another study carried out 7 weeks after lockdown and utilizing parent report, Orgilés et al. (2021) found that 56% of children scored above the clinical cut-off point for anxiety and 26.4% scored above the clinical cut-off for depression.

A few studies over the past months have used self-report measures for children and adolescents. Xie et al. (2020) found higher levels of depression among study participants in China and Duan et al. (2020) found that 23% of respondents from China suffered from depressive symptoms. Cao et al. (2020) similarly reported higher levels of generalized anxiety in college students from China (0.9% severe, 2.7% moderate, and 21.3% mild anxiety) during the quarantine. Duan et al. (2020) also reported (though not with exact percentages) higher levels of anxiety, with gender differences (i.e., more anxiety in females than in males) and age differences (i.e., more anxiety in adolescents than in children). Moreover, 55% and 36% reported that the pandemic has affected their learning or ability to graduate, respectively. Overall, in the relatively short duration during which researchers have examined impacts of COVID-19, most studies have reported negative psychological effects on children and adolescents who are impacted by national quarantines, and these impacts are occurring across numerous countries around the world (Brooks et al., 2020; Francisco et al., 2020; Liang et al., 2020; Orgilés et al., 2020, 2021).

At the family level, parents are usually the ones who must help their child(ren) to cope with the additional stress and emotional difficulties (e.g., anxiety and symptoms of depression) caused by school closures, remote learning, and children's confinement at home (Brown et al., 2020; Fegert et al., 2020; Halvorsen et al., 2020; Spinelli et al., 2020). Brooks et al. (2020) reviewed 24 studies published between 2004 and 2019 in different countries about the psychological impact of quarantine on adults and concluded that most studies reported negative psychological effects, including post-traumatic stress symptoms, confusion, and anger. The studies reviewed by Brooks et al. (2020) also suggested that longer durations of quarantine generally correspond with worse mental health symptoms. In a study of 3,055 adults from Spain aged 18–88 years, Rodríguez-Rey et al. (2020) concluded that 37% of these participants showed psychological distress due to the COVID-19 pandemic. Likewise, in China 40.4% of youth were prone to psychological distress (Liang et al., 2020).

Indeed, for the vast majority of individuals around the world, the life condition of families suddenly and deeply changed as a result of the COVID-19 pandemic. As one example, during quarantine in the home environment, the educational role of parents has become even much crucial than before. Children often have only their parents to provide support with homework (when necessary) and parents can become the central figure needed to promote a positive learning and developmental experience (Wang et al., 2020). Furthermore, parents of children with pre-existing psychological and behavioral difficulties are reporting problems with managing their children at home over this extended period (Colizzi et al., 2020; Marchetti et al., 2020a). Therefore, dealing with confinement and trying to balance factors such as personal life, professional responsibilities, and the education of one's child(ren) can be a stressful experience (Marchetti et al., 2020a,b; Mazza et al., 2020a,b; Spinelli et al., 2020). The study by Spinelli et al. (2020) in Italy is the only published report to date that explored the effect of COVID-19 on parents' stress. Their results showed that COVID-19 puts parents of children aged 2–14 years old at a higher risk of experiencing individual and dyadic distress during quarantine, potentially impairing their ability to be supportive caregivers. The researchers suggested that the lack of support many children are able to receive in such a difficult moment may be a reason for

their more pronounced psychological symptoms. Furthermore, some studies have shown that prolonged exposure to parental stress can result in another important phenomenon occurring during the pandemic: the so-called *parental related exhaustion*. Parental related exhaustion has been defined as feelings of being overextended and depleted of one's emotional and physical resources (Mikolajczak et al., 2018), which in turn influence psychological well-being of children. Indeed, in their study on parental-related exhaustion during the COVID-19 pandemic, Marchetti et al. (2020b) found that more than 80% of their sample reported high levels of distress and 17% experienced significant parenting-related exhaustion.

Some previous studies (e.g., Cao et al., 2020; Duan et al., 2020; Gómez-Becerra et al., 2020; Orgilés et al., 2020, 2021) have linked mental health problems, both in children and adults, with variables related to COVID-19 (e.g., fear of illness, death, having a family/friend infected,. . .), while other studies (e.g., Mikolajczak et al., 2018; Colizzi et al., 2020; Liang et al., 2020; Marchetti et al., 2020a,b; Spinelli et al., 2020) have related them to socio-demographic characteristics (e.g., having a larger number of children, lacking a domestic partner) or child features (e.g., special needs, externalizing symptoms, ADHD, behavior problems). However, further studies should examine this issue in even greater depth.

Purpose of the Present Study and Research Questions

Despite the important and relatively rapid development of research and reporting on psychological and educational impacts of national quarantine policies resulting from COVID-19, research in this area is still emerging and several gaps exist. For example, research focusing on psychological impacts of children aged approximately 9–14 years is limited and we are not aware of a single study that has specifically evaluated children with dyslexia. Given the research summarized at the beginning of this report, research must begin to carefully examine the impacts of school closures on students with dyslexia because they are already vulnerable to both learning and psychological difficulties. Additionally, there are no known psychoeducational-focused studies that have explored the impacts of COVID-19 quarantines on both children and parents within the same household. Such research will help to develop a more comprehensive picture of quarantine practices and policies on specific sub-populations of individuals. Furthermore, although some studies have been able to report on individuals' *physical* health before and during quarantine (e.g., through assessments of obesity and diabetes), we are not aware of any studies that have been able to directly assess children's or parents' psychological wellbeing at a time period just before quarantine and again within 1–2 months after quarantine began. Such data offer more direct, rather than retrospective, accounts of wellbeing and are therefore methodologically stronger in design.

Collectively, there are good reasons to expect that school closures together with self-isolation and social distancing present particular challenges for children and adolescents with dyslexia and we may expect that quarantines resulting from COVID-19 could increase psychological and educational problems in both parents and their children with dyslexia. However, this remains an empirical question and the main objective of this study is to examine the psychological and educational impact of COVID-19 quarantine on students with dyslexia (e.g., depression, anxiety, reading motivation, reading habits) and their parents (e.g., distress). In doing so, we seek to address some existing limitations within the rapidly emerging COVID-19 research on psychological wellbeing and aim to answer the following research questions (RQs)–based on both pre-quarantine and concurrent-quarantine data–from a sample of Spanish children with dyslexia and their parents.

RQ1: Based on self-report, what are the psychological (e.g., symptoms of depression and state anxiety) and reading-related impacts (e.g., perceived value of reading and actual engagement with reading, reading habits) of the 2020 national quarantine on children with dyslexia?

RQ2: For children with dyslexia, how does the quarantine impact the child's emotional and behavioral (e.g., conduct problems, hyperactivity-inattention problems) state as reported by a parent?

RQ3: To what extent does quarantine impact parental stress and other aspects of mental health for parents who have a child with dyslexia?

RQ4: Are there any pre-quarantine predictors of negative impact on children's emotional wellbeing or parent distress during the quarantine?

RQ5: During quarantine for children with dyslexia, what are some key educational conditions and impacts, as reported by a parent?

MATERIALS AND METHODS

Participants

Participants included 32 children with dyslexia as well as the mother of each child participant. Like each mother, fathers of the child participants were also asked to participate by completing measures used in the study; however, as will be described later, in only a small number of instances did the father collaboratively complete a measure with the child participant's mother. For brevity, we refer to the school-aged participants as "child" or "children" even though some participants' ages could be classified as early adolescence. Additional details about all study participants are provided below in the respective sub-sections.

The study respected all principles outlined in the current legislation on research investigations and was approved by the Research Ethics Committee of the University of Valencia, which is regulated by Ethical Principles for Medical Research Involving Human Subjects and aligns with the Declaration of Helsinki (World Medical Association [WMA], 2013). For example, prior to commencing any study procedures, parents' informed consent was obtained.

Children With Dyslexia

All 32 child participants were Caucasian, lived in Spain at the time of the study, and spoke Spanish as their primary language. Moreover, children were attending 21 schools (8 primary schools and 13 secondary schools). They ranged from 9 to 14 years old (mean age = 10 years and 11 months, *SD* = 1 year and 5 months. Seventeen identified as male and fifteen as female).

These participants were recruited from referrals to a multi-year investigation that began several years before the COVID-19 pandemic. Preliminary selection of potentially eligible child participants was consistent with past studies (e.g., Pereira-Laird et al., 1999; Soriano-Ferrer and Miranda, 2010; Begeny et al., 2011; Soriano-Ferrer et al., 2011), such that potential dyslexia participants in the present study were recommended by their teachers based on students' low reading achievement in the classroom. The actual presence of dyslexia for child participants was then determined by using the DSM-5 (American Psychiatric Association [APA], 2014) criteria specified for identifying students with a specific LD: (a) scores of 80 or above on an intelligence test (Cattell and Cattell, 2006), in order to exclude students with cognitive impairments; (b) no evidence or history of neurological damage, significant economic disadvantage, emotional disturbance, hearing or vision abnormalities, or any other major handicapping condition; and (c) a reading achievement score at or below the 25th percentile on the word-reading and/or pseudoword-reading skill subtests (accuracy and/or speed) from the Standardized Reading Skills Battery (PROLEC-R, Cuetos et al., 2002; PROLEC-SE, Ramos and Cuetos, 2003).

Three participants (9.4%) had been retained in a grade, 46.9% had received services in the school's resource room prior to this study, and 87.5% were reported by the teacher as needing help with homework. Eleven (34.4%) of the children had no siblings, 53.1% had a sibling, and 12.5% had two or more siblings. **Table 1** shows the characteristics of all child participants.

Parents/Caregivers of Children With Dyslexia

Each mother of the 32 aforementioned children participated in this study. Like the child participants, these caregivers (henceforth referred to as *parents*) had also participated in past components of this multi-year investigation. **Table 2** includes parents' demographic information and includes fathers' information to provide a clearer picture of child participants' parents. Mothers' age ranged from 30 to 52 years (mean age = 42 years, 1 month, *SD* = 4 years, 1 month), and fathers' age ranged from 38 to 60 years (mean age = 44 years, 2 months, *SD* = 4 years, 8 months). Most parents' highest level of education (53.1% of mothers and 65.5% of fathers) was a diploma from Secondary School. Approximately 22–24% of mothers and fathers had a degree from a university. All fathers and 69% of mothers reported having a paid job. In accordance with the International Standard Classification of Occupations (International Labour Organization [ILO], 2012), the occupations of fathers and mothers were distributed into occupations with four levels of skills (see **Table 2**). Due to the COVID-19 pandemic, some parent participants lost their jobs (9.4% of mothers and 3.4% of fathers), and others had their working hours reduced (18.7% of mothers and 34.5% of fathers). Additionally, 68.7% ($n = 22$) of the parents were married or living together, 9.4% ($n = 3$) reported being single or widowed, and 21.9% were separated ($n = 7$).

Measures

Twelve total measures were used for purposes of this study, most of which were administered both before and during Spain's 2020 national quarantine. For clarity in our method, each section specifies if the respective measure was completed before quarantine, during quarantine, or both.

TABLE 1 | Characteristics of child participants.

	M	***SD***
Age	10.96	1.49
IQ	106.78	10.64
Word reading accuracy	34.16	5.32
Word reading speed	79.60	32.28
Word reading fluency	49.95	19.64
Pseudoword reading accuracy	28.84	7.26
Pseudoword reading speed	95.69	33.28
Pseudoword reading fluency	34.03	15.07
Sex	***N***	%
Male	17	53.1
Female	15	46.9
Academic Qs	***N***	%
Grade retention	3	9.4
Resource room	15	46.9
Homework Help	28	87.7
Siblings	***N***	%
No siblings	11	34.4%
1 Sibling	17	53.1%
>2	4	12.5%

TABLE 2 | Characteristics of parent participants.

	Mothers (N = 32)		***Fathers (N = 29)***	
	M	***SD***	***M***	***SD***
Age (years)	42.2	4.2	44.3	4.9
Highest level of education completed	***N***	%	***N***	%
Elementary	8	25	3	10.3
Secondary	17	53.1	19	65.5
University	7	21.9	7	24.1
Occupation[a]	***N***	%	***N***	%
Without a paid job	10	31.2	0	0
Skill level 1	12	37.5	4	13.8
Skill level 2	5	15.6	20	69.0
Skill level 3	5	15.6	5	17.2
Skill level 4	0	0	0	0

[a]*Based on the International Standard Classification of Occupations (International Labour Organization [ILO], 2012).*

Measures Completed by Each Child Participant

Factor "g" intelligence test (scale 2, form A)

This intelligence test (Cattell and Cattell, 2006) was administered to child participants prior to the quarantine to assess general mental capacity without the interference of verbal stimuli. The reliability of the Spanish adaptation of this intelligence test is 0.86. In the current sample, the Cronbach's alpha was 0.79.

Standardized reading skills battery

Prior to the quarantine, each child's word and pseudoword reading skills were measured with the Standardized Reading Skills Battery (PROLEC-R, Cuetos et al., 2002; PROLEC-SE, Ramos and Cuetos, 2003). Word reading requires the correct identification of 40 words that vary greatly in frequency, length and spelling structure (CCV, CVV, CVC, CCVC, CVVC, and VC, where C = consonant and V = vowel), and pseudoword reading consists of pronouncing 40 pseudowords, constructed by changing or adding one or two letters to each of the 40 words on the reading test. In word and pseudoword reading, task completion is timed. Two combined scores of fluency are obtained, one based on word reading fluency and the other on pseudoword reading fluency. In both cases, the child's score consists of an accuracy score divided by the reading speed, measured as the time taken to complete the task, and then multiplied by 100. These reading batteries have adequate internal consistency with a Cronbach's alpha >0.70 for words and pseudowords reading in both the normalization sample and the current one.

Children's depression inventory-short form

Before and during quarantine, depressive symptoms were measured using the Children's Depression Inventory-Short Form (CDI-S) (Kovacs, 1992), which is a self-assessment screening tool of 10 items. Children mark one of three statements best describing their feelings within the past 2 weeks. Items statements indicate the severity of depressive symptomatology and are arranged in either increasing or decreasing order. Total scores range from 0 to 20, whereas high sum scores indicate a more severe symptomatology. The Spanish adaptation of this inventory for children, ranging from 9 to 15 years old, has adequate reliability with a Cronbach's alpha of 0.71 (Del Barrio et al., 2002). In the current sample, the Cronbach's alpha was 0.69.

State-trait anxiety inventory for children

Before and during quarantine, children completed the state anxiety subscale of the Spanish adaptation of the State-Trait Anxiety Inventory for Children (STAIC) (Spielberger, 2014). The state anxiety subscale evaluates the current state of anxiety, asking how respondents feel "right now," using items that measure subjective feelings of apprehension, tension, nervousness, worry, and activation/arousal of the autonomic nervous system. This subscale includes 20 Likert-type items, scoring on a three-point scale, ranging from 1 (almost never) to 3 (almost always). The Cronbach's alpha is reported to be 0.94 (Spielberger, 2014). In the current sample, the Cronbach's alpha was 0.90.

Motivation to read profile-revised

Before and during quarantine, children responded to the Motivation to Read Profile-Revised (MRP) (Malloy et al., 2013), The 20-item survey assesses two specific dimensions of reading motivation: self-concept as a reader and value of reading. The items that focus on self-concept as a reader are designed to elicit information about students' self-perceived competence in reading and their self-perceived perception relative to peers. The value of reading items elicits information about the value students place on reading tasks, particularly in terms of frequency of reading engagement and reading-related activities. Students respond to items using a 1–4 Likert scale, with four representing the most positive response. Cronbach's alpha revealed a moderately high reliability for both subscales (self-concept = 81; value = 0.87) and for the full scale 0.87 (Malloy et al., 2013). In the current sample, the Cronbach's alpha was 0.87, 0.95, and 0.97, for self-concept, value and total scale respectively.

Task-value scale for children

Before and during quarantine, children's task motivation was measured in an interview using the Task-value Scale for Children (TVS-C) (Nurmi and Aunola, 2005; Aunola et al., 2006). This scale measures children's task motivation in school and in home. In the present study, we used the three items measuring children's intrinsic value (e.g., "How much do you like doing reading-related tasks at home?". Each item was rated on a five-point Likert scale (1 = I do not like it at all/I dislike doing those tasks; 5 = I like it very much/I really enjoy doing those tasks). A sum score for subject-related intrinsic value was created by calculating the mean of the three scores for the three items. Cronbach's alpha is reported to be 0.88 (Aunola et al., 2006). In the current sample, the Cronbach's alpha was 0.84.

Reading activity inventory

Before and during quarantine, the Reading Activity Inventory (RAI) was used to measure the breadth (genres read) and frequency (how often a genre was read) of students' reading (Guthrie et al., 1994). The shortened version of 10 items by Wigfield and Guthrie (1997) was used in this study. The children were asked to answer five questions about what they read (mystery books, sports books, adventure books, comic/magazine and nature books) and how often they read for fun. If the child indicated that a given kind of book was read in the last week, the child was then asked to give its title. The child then is asked to indicate how often he or she reads that kind of book, responding on a 1–4 scale from almost never to almost every day. Although there is no traditional reliability for this measure, the fall and spring administrations of the measure correlated 0.54 ($p < 0.001$), suggesting a substantial level of stability in the measure (Wigfield and Guthrie, 1997). In the current sample, the Cronbach's alpha was 0.84 for breadth and 0.70 for frequency of reading.

Measures Completed by a Parent of Each Child Participant

Demographic information questionnaire

At the very beginning of the study, parents supplied information about their sex, level of education, occupation (based on the International Standard Classification of Occupations), and marital status. They also responded to items about the number of children being raised in the child participant's home and the child participant's past and current schooling (e.g., number of grade retentions, whether they received homework help).

Strengths and difficulties questionnaire

Before and during the quarantine, parents were asked to complete the Spanish version of the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 2001; Ortuño-Sierra et al., 2017) which is designed to gather information about emotional and behavioral difficulties experienced by children from 4 to 17 years old. The current study focuses specifically on the following subscales: *emotional symptoms* (e.g., often unhappy, down-hearted), *conduct problems* (e.g., often has temper tantrums or hot temper) and *hyperactivity-inattention* (e.g., restless, overactive, cannot stay still for long). Each subscale is measured by five items, rated by a three-point scale ranging from 0 (strongly disagree) and 2 (strongly agree). To obtain the total scores, items are summed. Normative data of Español-Martín et al. (2020) that set at 90th percentile as the clinical cut-off range were used. The test has been shown to have criterion validity and good test–retest reliability after 4 and 6 months (mean = 0.62). Furthermore, the internal consistency is satisfactory, with a Cronbach's alpha ranging from 0.57 to 0.88 (Goodman, 2001). The Spanish adaptation by Ortuño-Sierra et al. (2017) showed an internal consistency for Total Difficulties score of 0.84, ranging from 0.75 to 0.78 for the SDQ subscales. In the current sample, the Cronbach's alpha was 0.96 for emotional problems, 0.92 for conduct problems, and 0.82 for hyperactivity-inattention.

Parenting stress index-short form

Before and during the quarantine, the Parenting Stress Index–Short Form (PSI-SF) was used to evaluate parenting and family characteristics–with the aim of identifying potential for parental behavior problems and child adjustment difficulties within the family system (Abidin, 1995). In this study, we used the Spanish PSI-SF (Díaz-Herrero et al., 2010, 2011). PSI-SF includes 36 items and yields a Total Stress Score from three scales (12 items per scale): Parental Distress (PD), Parent–Child Dysfunctional Interaction (PCDI), and Difficult Child (DC). Each item is scored on a five-point Likert scale, from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating greater levels of parental stress. The PD domain measures the distress experienced by parents due to personal factors, such as depression or conflict with a partner, or life restriction due to the demands of childrearing in their role as parents. The PCDI domain focuses on the perception of the child as not responsive to parental expectations. The DC subscale represents behaviors that children often engage in that may make parenting easier or more difficult. The scale also provides a measure of total stress by adding up the scores of the 36 total items. The PSI-SF shows high internal consistency (Cronbach's alpha): 0.84 (PCDI), 0.82 (PD /DC), and 0.90 for Total Stress. In the current sample, the Cronbach's alpha was 0.70 for PD, 0.80 for PCDI, 0.73 for DC, and 0.86 for total stress.

The general health questionnaire

During the quarantine, parent mental health was measured using the 12-item General Health Questionnaire (GHQ-12) (Goldberg et al., 1997), which is a self-assessment screening tool. The Spanish version of this questionnaire has good psychometric properties and the Cronbach's alpha coefficient was 0.86 for persons of ≤65 years and 0.90 for ≥65 years (Rocha et al., 2011). The questionnaire includes response options that range from 0 (never) to 3 (usually). Total scores range from 0 to 36 with higher scores indicating higher degrees of disturbance of the general health status. A total score higher than 12 points (Percentile score >75) indicates a "tendency toward psychological problems." In the current sample, the Cronbach's alpha was 0.75.

Questionnaire about educational conditions and potential impacts of quarantine on children with dyslexia

Developed for the purposes of this study and to align specifically with educational issues potentially occurring during the COVID-19 pandemic, we used a 16-item questionnaire during the quarantine to ask parent participants questions about remote learning, time spent on learning, difficulties in homework, help from teachers, and some educational worries of parents during the national quarantine. For brevity, we will henceforth refer to this measure as the *Quarantine Questionnaire about Education* (QQE). **Table 6** summarizes all questions that were asked in the QQE.

Procedure

Parents provided informed consent during the initial evaluation of each child's Factor "g" Intelligence Test, Standardized Reading Skills Battery, and demographic information questionnaire which occurred between November 1, 2019 and January 23, 2019. An experienced and licensed clinical psychologist (an author of this paper) administered the intelligence and reading assessments in random order and in a setting free from noise and distractions. Test sessions varied in length depending on the participant being assessed. Following these assessments, between February 2 and 11, 2020, the additional child measures were administered by the same clinical psychologist in random order through an interview. Mothers completed the measurements while their son was being interviewed. In May 2020, each evaluation administered during the quarantine was carried out in two or three sessions by means of telephone interviews or by videoconference (with Blackboard Collaborate) with the children and their parents. Thus, CDI-S, STAIC, MRP, TVR-C, RAI, SDQ, and PSI-SF were filled before and after quarantine in a random order, while GHQ-12 and QQE were filled only during confinement. This assessment corresponded to approximately 1.5 months (i.e., 45–47 days) after the national quarantine began in Spain. Parent participants who had multiple children in the household were specifically asked to respond to all questions and surveys for the specific child participant in the study. Measures intended for parents (i.e., the SDQ, PSI-SF, GHQ-12, and QQE) were mainly completed only by the child participant's mother (81.2%; n = 26); however, for 18.7% (n = 6) of the child participants, the SDQ was completed collaboratively by both parents. The PSI-SF, GHQ-12, and QQE were completed only by mothers.

Data Analysis

We analyzed data using SPSS version 24. First, descriptive statistics were used to describe the participants' characteristics before quarantine (see **Tables 1**, **2**) and to analyze educational data regarding to our RQ 5. Thus, descriptive statistics were

provided as a mean and SD for continuous variables; frequencies and percentages were used for categorical variables. Regarding analysis for our RQs 1, 2, and 3 we used paired *t* tests to evaluate the significance of changes (before and during quarantine) in children with dyslexia and their parents. To control for multiple comparisons, the level of significance was established after applying the Bonferroni correction (0.05/15 = 0.003). We report effect sizes using the Cohen's *d*, with values between 0.00 and 0.20 considered small effect sizes, values between 0.20 and 0.50 considered medium, and values above 0.80 considered large effect sizes. Finally, in order to analyze data regarding RQ 4, based on previous studies (Mikolajczak et al., 2018; Colizzi et al., 2020; Marchetti et al., 2020a,b; Spinelli et al., 2020) we carried out different multiple linear regression analyses to find out if any pre-quarantine variables influenced children's emotional problems (e.g., anxiety) or parents' stress during quarantine.

RESULTS

Psychological and Reading-Related Impacts of Quarantine as Reported by Children With Dyslexia (RQ 1)

As measured by the CDI-S and STAIC respectively, children with dyslexia showed significantly higher levels of depression ($t_{(31)} = -8.1$, $p = 0.001$, $d = -1.4$) and state anxiety ($t_{(31)} = -6.6$, $p = 0.001$, $d = -1.2$) during the quarantine compared to before the quarantine period, with large effects sizes in both cases (see **Table 3**). Note that *t*-scores and Cohen's *d* are negative when a variable increased during quarantine and are positive when is the score is lower during quarantine.

TABLE 3 | Psychological and motivational impact of Spain's National Quarantine on children with dyslexia.

	Before quarantine		During quarantine		$t_{(31)}$	*p*	*d*
Measure	**Mean**	**SD**	**Mean**	**SD**			
Depression (CDI-S)	3.0	2.5	5.3	1.9	−8.1	0.001	−1.4
State anxiety (STAIC)	42.7	7.6	47.5	6.56	−6.6	0.001	−1.2
Reading motivation (MRP)							
Reading Self-Concept Subscale	21.9	3.3	21.6	2.8	1.7	0.096	−0.3
Value of Reading Subscale	25.1	4.3	22.7	5.2	6.9	0.001	1.2
Total Score on MRP	47.0	5.5	44.3	6.1	7.7	0.001	1.4
Task-Value (TVS-C)	9.1	2.7	5.9	2.1	10.1	0.001	1.8
Reading activity (RAI)							
Breadth of Reading	1.5	1.0	0.7	0.9	6.6	0.001	1.2
Frequency of Reading	1.1	0.4	1.0	0	1.6	0.129	0.3

t-scores and Cohen's d are negative when a variable increased during quarantine, and are positive when is the score is lower during quarantine.

As measured by the MRP, children with dyslexia also had significantly lower scores during the quarantine on the Value of Reading subscale ($t_{(31)} = 6.9$, $p = 0.001$, $d = 1.2$) and Reading Motivation total score ($t_{(31)} = 7.7$, $p = 0.001$, $d = 1.4$). Similarly, children's task-value motivation, as measured by the TVS-C, also decreased at significant levels during quarantine ($t_{(31)} = 10.1$, $p = 0.001$, $d = 1.8$). With each of these changes, we observed large effect sizes (*d* range = 1.2–1.8).

Regarding reading activity, children on average reported through the RAI that they significantly decreased their breadth of reading during quarantine ($t_{(31)} = 6.6$, $p = 0.001$, $d = 1.2$) and most children decreased the types of books they read. In the before quarantine period, 18.8% ($n = 6$) of child participants indicated they did not read any type of book last week, and 81.3% ($n = 26$) read between one and three types of books. In contrast, during the quarantine, 50% ($n = 16$) reported they did not read any books last week. However, there were no statistically significant differences in children's reported frequency of reading. Specifically, before the quarantine, 90.6% of the children with dyslexia reported they "almost never" read for fun and then 100% reported this during the quarantine. The restricted variability may have influenced a lack of statistically significant findings (i.e., even before quarantine, 90% of the children almost never read for fun).

Parent Perspectives of Emotional and Behavioral States for Children With Dyslexia (RQ 2)

Overall, parents reported some significant changes in children's emotional and behavioral symptoms (rated using the SDQ scale) before and during the quarantine (see **Table 4**). According to parents' ratings, children with dyslexia scored significantly higher during the quarantine than before the quarantine on all three subscales: Emotional Symptoms ($t_{(31)} = -4.5$, $p = 0.001$, $d = -0.8$), Conduct problems ($t_{(31)} = -5.1$, $p = 0.001$, $d = -0.9$), and Hyperactivity-Inattention ($t_{(31)} = -7.0$, $p = 0.001$, $d = -1.2$), with large effect sizes in all cases. **Table 4** also shows that the percentage of participants rated above the clinically significant range on the SDQ was higher during the quarantine period than before the quarantine. Before the quarantine, the percentage of children with clinical scores ranged from 3.1% for Hyperactivity-Inattention to 15.5% for Emotional Symptoms; however, during the quarantine, the percentage of children rated with clinically significant scores ranged from 18.8% (for Hyperactivity-Inattention) to 53.1% (for Emotional Symptoms.

Mental Health Impacts of Quarantine on the Parents Who Have a Child With Dyslexia (RQ 3)

Using the PSI-SF, parent participants reported significant changes in parenting stress during the quarantine (see **Table 5**). For example, during quarantine parents reported higher scores on the subscale areas of Parental Distress ($t_{(31)} = -14.4$, $p = 0.001$, $d = -2.4$), Parent-Child Dysfunctional Interaction ($t_{(31)} = -10.2$,

TABLE 4 | Parents' perceived impact of Spain's National Quarantine on emotional and behavioral difficulties of children with dyslexia.

	Before quarantine			During quarantine			$t_{(31)}$	p	d
SDQ domains	**Mean**	**SD**	**% (*N*)[a]**	**Mean**	**SD**	**% (*N*)[a]**			
Emotional symptoms	3.1	2.5	15.6 (5)	3.9	2.5	53.1 (17)	−4.5	0.001	−0.80
Conduct problems	1.3	1.5	9.4 (3)	2.1	1.8	21.9 (7)	−5.1	0.001	−0.90
Hyperactivity-inattention	3.3	1.4	3.1 (1)	4.7	1.3	18.8 (6)	−7.0	0.001	−1.24

[a] *Percentage (%) and N with Clinically Elevated Score; t-scores and Cohen's d are negative when a variable increased during quarantine, and are positive when is the score is lower during quarantine.*

TABLE 5 | Impact of Spain's National Quarantine on the stress of parents with a child who has dyslexia.

	Before quarantine		During quarantine		$t_{(31)}$	p	d
PSI-SF	**Mean**	**SD**	**Mean**	**SD**			
PD	27.6	6.1	44.5	5.7	−14.4	0.001	−2.4
PCDI	24.0	3.3	36.5	7.2	−10.2	0.001	−2.0
DC	26.6	4.9	35.6	6.0	−7.2	0.001	−1.7
Total stress	**78.1**	**7.4**	**116.6**	**11.8**	**−21.4**	**0.001**	**−3.8**

PD = Parental Distress; PCDI = Parent–Child Dysfunctional Interaction; DC = Difficult Child.t-scores and Cohen's d are negative when a variable increased during quarantine, and are positive when is the score is lower during quarantine.

$p = 0.001$, $d = -2.0$), and Difficult Child ($t_{(31)} = -7.2$, $p = 0.001$, $d = -1.7$). Given the subscale increases in stress during the quarantine, the Total Stress scale was also significantly higher ($t_{(31)} = -21.4$, $p = 0.001$, $d = -3.8$). Furthermore, 31.3% of mothers scored above the clinically significant range (with a Percentile Score >75) on the GHQ-12, showing a tendency toward psychological difficulties during the quarantine.

Predictors of Negative Impacts of Quarantine on Children's Emotional Difficulties and Parents' Stress (RQ 4)

Finally, in order to determine if any pre-quarantine variables influenced children's emotional problems (e.g., anxiety) or parents' stress during quarantine different models of multiple linear regression have been run. In the case of children, we used different pre-quarantine variables as independent variables (e.g., marital status, number of siblings, parent-child interaction,. . .) and level of anxiety and depression during quarantine as dependent variables. In the case of the parents, different pre-quarantine variables (e.g., marital status, number of children, child's behavioral problems,. . .) were used as independent variables and the total stress score during quarantine was the dependent variable.

When predicting children's emotional problems during confinement, the model that was significant ($F_{(2,29)} = 10.773$, $p < 0.001$) explained 38% (adjusted $R^2 \times 100$) of the state anxiety experienced by the children during quarantine. The pre-quarantine predictors that were significant were parent-child dysfunctional interaction ($\beta = 0.405$, $t = 2.69$, $p < 0.05$) and the marital status [1 = married or cohabitating; 0 = living alone] of their parents ($\beta = -0.434$, $t = -2.94$, $p < 0.01$).

In the case of parents, the model that was significant ($F_{(3,28)} = 17.170$, $p < 0.001$) explained 61% (adjusted $R^2 \times 100$) of parental stress during quarantine. The pre-quarantine variables that were significant were the number of children ($\beta = 0.256$, $t = 1.67$, $p < 0.05$), marital status ($\beta = -0.677$, $t = -4.82$, $p < 0.001$), and the child's behavior problems ($\beta = 0.312$, $t = 2.07$, $p < 0.05$).

Educational Conditions and Impact of Quarantine on Children With Dyslexia, as Reported by Parents (RQ5)

Frequencies and percentages of the educational conditions and challenges are shown in **Table 6**. As shown, approximately 90% of parents reported having electronic devices for remote learning, although 71.9% also reported that such electronic devices were shared by other family members, such as siblings and parents. In relation to remote learning, 100% of teachers used online tasks through software such as Moodle, but only 21.9% occasionally attended their classes online with a teacher present. Parents reported that 56.2% of children spent less than 4 h per day on learning and 43.8% spent between 4 and 7 h. Further, 56.3% of children with dyslexia used audiobooks and/or readers for completing the school reading activities.

All parents of children with dyslexia reported difficulties in establishing study routines and homework completion. In fact, 100% of parents indicated their child needs help with homework. The majority of parents (90.6%) spent more than 3 h per day supporting their child's learning and 96.9% (all but one parent) indicated that the pandemic has negatively affected their child's learning. At the time of the survey, all but two parents responded "no" when asked if the child's teacher assisted the parent with knowing how to best support the student with homework. Similarly, 68.9% of parents reported they had difficulties cooperating with the child's teachers and that their child had difficulties completing tasks on time. The large majority (78.1%) of parents indicated that their child with dyslexia received less support for reading difficulties during quarantine, none received a similar amount, and 21.9% reported that the child received no special attention for their reading difficulties. Finally, the majority of parents were very worried about the child's learning and school success (100%), the child's motivation and interest in reading and in learning (84.4%), the child's peer relations (78.1%), and the professional skills of the child's teacher (71.9%).

DISCUSSION

The COVID-19 outbreak was a new and unexpected situation that quickly became a large-scale pandemic. Within Spain, and likely other countries, many have argued that the consequences of school closures and keeping children locked at home to prevent the spread of COVID-19 did not fully consider other important aspects of families' and children's wellbeing–including but not

TABLE 6 | Educational conditions and potential challenges reported by parents during Spain's National Quarantine.

Summary of all survey questions and response options on the QQE	*N*	%
Child has access to electronic devices to use for learning		
Yes, and is the only person in household to use that device	6	18.8
Yes, but shared with others (siblings, parents)	23	71.9
No	3	9.4
Child completes online classes with teachers		
Yes	7	21.9
No	25	78.1
Online tasks (e.g., Moodle)	32	100
The average time per day each child spends on learning (in total hours per day)		
≤4 h	18	56.2
4–7 h	14	43.8
≥7 h	0	0
Child needs help with homework during quarantine		
Yes	32	100
No	0	0
Average time per day supporting your child(ren) with learning during quarantine		
Less than 1 h	0	0
1–2 h	3	9.4
3–4 h	23	71.9
More than 4 h	6	18.7
Use of audiobooks and/or readers for school reading activities		
Yes	18	56.3
No	14	43.8
Difficulties in establishing study routines and with homework		
Yes	32	100
No	0	0
Difficulty completing tasks on time		
Yes	20	62.5
No	12	37.5
Quarantine has negatively affected your child's learning		
Yes	31	96.9
No	1	31.1
Difficulties cooperating with the teacher		
Yes	22	68.8
No	10	31.3
The teacher helped me understand how to best support my child with homework		
Yes	2	6.3
No	30	93.8
Is special attention offered by your child's teacher to improve reading skills during quarantine?		
Yes, with similar amount of attention before quarantine	0	0
Yes, but with less attention during quarantine	25	78.1
No	7	21.9
Which of the following are you most worried by during the quarantine (select all that apply):		
The child's learning and school success	32	100
Professional skills of child's teacher	23	71.9
The child's motivation and interest in learning and reading	27	84.4
The child's peer relationships	25	78.1

This survey was developed for the purposes of this study and to understand educational circumstances during Spain's 2020 national quarantine and response to COVID-19. Each bolded item summarizes the question posed to the parent and immediately below each bolded item are the response options. QQE = Quarantine Questionnaire about Education.

limited to their psychological and educational wellbeing (Smith, 2020; United Nations Educational, Scientific, and Cultural Organization [UNESCO], 2020). Recently published studies have begun to demonstrate several negative impacts of quarantine on students' mental health and schooling (e.g., Brooks et al., 2020; Francisco et al., 2020; Gómez-Becerra et al., 2020; Orgilés et al., 2020, 2021), but to our knowledge, our study is the first to specifically examine the psychological and educational impact of the COVID-19 pandemic on students with dyslexia as well as the parents of students with dyslexia. It is also one of only a small number of studies with data collected about participants' wellbeing shortly before and then again during the quarantine.

First and foremost, our findings highlight several negative psychological and educational impacts that national quarantine conditions can have on students with dyslexia and in their parents. Using self-report measures, our participants with dyslexia showed significantly increased symptoms of depression and state anxiety during the quarantine. This finding is generally consistent with other recent studies that included children and adolescents without learning disabilities (e.g., Cao et al., 2020; Duan et al., 2020; Francisco et al., 2020; Xie et al., 2020; Orgilés et al., 2021), but our study helps to evidence participants' degree of mental health changes from before to during quarantine conditions. Our study also bolstered data from children's self-reports about mental health by including parental reporting. Specifically, during the quarantine compared to before, we found that parents rated their child with dyslexia to have significantly more emotional difficulties, conduct problems, and hyperactivity-inattention (as measured with the SDQ). We also found that during the quarantine, the percentage of students with dyslexia who were above the clinical cut-off range was 53.1% for Emotional Symptoms, 21.9% for Conduct Problems, and 18.8% for Hyperactivity-Inattention. Our results are the first to document such changes from before to during quarantine conditions, but children's presence of difficulty during the quarantine correspond well with the findings reported by Gómez-Becerra et al. (2020). In their study, which evaluated a wide range of individuals during the quarantine between 3 and 18 years old (all living in Spain), they found similar percentages of students with clinically elevated scores on the SDQ: 48.6% for Emotional Symptoms, 24.2% for Conduct Problems, and 20.3% for Hyperactivity-Inattention.

Conditions of COVID-19 and Spain's national quarantine also had a negative influence on our participants' reading motivation

and reading activity. For instance, during quarantine, children reported significantly less motivation for reading on measures of the MRP and TVS-C and significantly less breadth of reading on the RAI. These findings are important because they clearly highlight a critical need to support students with dyslexia during atypical schooling conditions, just as it is well understood that such students should be well supported under more typical school conditions (Nelson and Harwood, 2011a; Morte-Soriano et al., 2020). These findings are also important because one cannot assume that most students will have less reading motivation during quarantine conditions. For instance, studies of adults and children without learning disabilities suggest that many such individuals have spent even more time reading, and read with greater breadth, during quarantine conditions (Adeyemi, 2020; Tyagi et al., 2020).

Another goal of our study was to explore the predictive power of different pre-quarantine variables to potentially explain emotional problems in children with dyslexia during quarantine. Thus, pre-existing conditions like difficult interaction between parent-child, and living with a divorced / separated or single parent, seem to have a great impact on the state anxiety of children with dyslexia. Previous research has shown that parental status (e.g., divorced or single) seems to comprise a risk factor for fear and anxiety, and health risks and fear connected to COVID-19 influence parents' levels of stress both at the individual level (e.g., being over-reactive, feeling nervous, irritable) and at the dyadic level (e.g., parent-child dysfunctional interactions, finding it difficult to enjoy interactions with the child, and child behavioral and emotional expressions); and, as a consequence, children's psychological problems are impacted (Spinelli et al., 2020). Similarly, Orgilés et al. (2020, 2021) found a relationship between parents' stress and their children's emotional state. In other words, these studies show that anxiety and depression symptoms were more likely in children whose parents reported a higher level of stress. In fact, primary caregivers' level of stress was related to 25 of 31 child symptoms (Orgilés et al., 2020). As Marchetti et al. (2020b) point out, parents experiencing high psychological distress may be less attentive to and warm with their children, and they may also transfer the burden of their emotional distress to their children, which could affect their children's adjustment.

Our study also highlighted the impacts of quarantine conditions and the relative wellbeing of parents who have a child with dyslexia. Findings showed that compared to pre-quarantine conditions, mothers reported significantly greater stress and undesired interactions with their child during quarantine. These findings are new and important to report in the context of evaluating parents of students with dyslexia, but the data appear consistent with what might be expected during a quarantine. For instance, some studies point out that dealing with confinement is a particularly stressful experience for parents who must balance personal life, work, and raising children (Marchetti et al., 2020a,b; Mazza et al., 2020a,b; Spinelli et al., 2020). In the case of students with dyslexia, parents must cope with poor academic progress, a greater need to help with homework, and seek appropriate help for reading instruction or support. Additionally, approximately one-third of mothers scored above the clinically significant range on the GHQ-12, further elucidating the high levels of psychological distress (an emotional state characterized by depressive and anxious symptoms) during quarantine conditions. These results are generally consistent with those reported by others. In Spain, Rodríguez-Rey et al. (2020) reported that 37% of adults experienced psychological distress, in China Liang et al. (2020) reported that 40.4% of youth were prone to psychological distress and in Italy, more than 80% of their sample reported high levels of psychological distress and 17% reported parenting-related exhaustion (Marchetti et al., 2020b).

The present results also revealed some predictors of parents' stress during quarantine, such as number of children, marital status (e.g., divorced or single), and the child's behavior problems. This finding is in line with previous studies (Mikolajczak et al., 2018; Marchetti et al., 2020a,b; Spinelli et al., 2020) that have highlighted risk factors for parenting stress, relating to socio-demographic characteristics (e.g., having a larger number of children, lacking a domestic partner) or child features (e.g., special needs, externalizing symptoms, ADHD, behavior problems). However, further studies should examine this issue in even greater depth.

Consistent with parental reports of distress, most if not all the parents in our study reported, for example (a) their child having difficulty with establishing study routines and completing school-related tasks on time, (b) spending on average three or more hours each day assisting children with learning, (c) negative overall impacts on their child's learning and less attention from the child's teacher to support reading skills, and (d) not getting sufficient support from the child's teacher. Obviously, facing such circumstances during more than a month of quarantine is likely to significantly increase parents' risk of stress, including parents of children without learning disabilities (Spinelli et al., 2020).

Study Limitations, Implications, and Future Research Directions

As an initial evaluation of quarantine conditions on students with dyslexia and their parents, our study should be understood while considering its limitations. For example, this study used child and parent wellness reports; however, only mothers completed all measures. Mothers' and fathers' ratings should be considered in future studies in an attempt to determine whether mothers or fathers perceive wellbeing similarly. Also, future research should attempt to add observational measures. This is indeed a challenging task during quarantine, but with significant resources, video recording could be used as a possible means of direct observation. Also, our sample is not representative of all students in Spain (or students globally) with dyslexia and future research is needed over time to gather data from a larger and even more representative sample. Similarly, future research should aim to broaden our understanding of how quarantine conditions impact children's educational and psychological wellbeing by including additional measures (e.g., direct assessments of reading during quarantine, more comprehensive assessments of depression or anxiety) and exploring possible mediators or moderators among variables. Components of time (e.g., for how long has the child or parent

been experiencing quarantine) and specific behavior (e.g., to what degree has "typical" educational conditions, such as in-person schooling, changed during quarantine) must also be examined to understand short-term and long-term impacts of quarantine. Although it is impossible to know for sure right now whether negative impacts of quarantine will improve or worsen over time, many have argued that psychological and educational impacts will worsen over time (Brooks et al., 2020; Gómez-Becerra et al., 2020), especially for those who are most economically, educationally, or psychologically vulnerable (Miranda et al., 2005, 2008, 2013; Soriano-Ferrer and Contreras, 2012; Bonifacci et al., 2019; Asbury et al., 2020; Colizzi et al., 2020; Marchetti et al., 2020a; Smith, 2020; Iriarte-Redín et al., 2021).

With limited research currently available on the impacts of quarantine conditions on children with dyslexia and their parents, we choose not to overstate our findings by offering in depth implications or recommendations. One simple observation is that much more research is needed to better understand the impacts of COVID-19 on educational and psychological wellbeing and understand how to best address all negative impacts with prevention and intervention. Clearly, negative impacts were observed during quarantine compared to pre-quarantine conditions for the participants in our study (and those of other studies), but given the unprecedented circumstances of this pandemic, it is unknown to what degree we would expect this level of negative impact. A pandemic is inevitably going to have negative impacts across a range of areas–including but not limited to mental health and education–but it is impossible to know at this time to what extent national policies and practices during quarantine minimized the greatest possible harm of a pandemic. For this reason, national and international research directly examining psychoeducational impacts of COVID-19 (and quarantines more specifically) is essential so that policies and strategies can align with needs and actions that best minimize harm in large-scale and equitable ways. Using frameworks of internationalization (e.g., van de Vijver, 2013; Begeny, 2018; Begeny et al., 2018; Bernardo et al., 2018), such research (within and across countries) can leverage understanding, knowledge, and culturally appropriate best practices for schooling, mental health, and more. Although COVID-19 is a global concern, its impacts may look differently within and across different countries; thus, an internationalization framework for research can help researchers, service providers, and policy makers to understand, for example, how different countries are attempting to evaluate and address psychological and educational impacts–and to what extent can we learn from other nations' efforts to minimize harmful effects of mandatory quarantine on psychoeducational outcomes.

Until more abundant research is available, converging evidence in the past year offers one clear implication: because quarantine conditions are negatively impacting large percentages of children and families, immediate and evidence-informed actions must be used to remediate or at least slow the widespread, negative, psychoeducational impacts. In numerous ways, psychologists and educators can help in this effort, including efforts to assist students with dyslexia and their families. For example, professionals can work to implement virtual interventions if face-to-face intervention is not possible or feasible–and in doing so, aim to select interventions that have contextually appropriate evidence of being effective (at least within face-to-face contexts if virtual implementation has not yet been tested) and closely attend to intervention effectiveness at the individual level so that treatment adjustments can be made immediately to best support the individual. Intervention or prevention efforts must also consider multiple aspects of students' learning or psychological wellbeing, such as by offering guidance for students' teachers within schools and, when appropriate, for parents in home. As evidenced in numerous studies well before COVID-19 (e.g., Soriano-Ferrer et al., 2011), intervention may need to be individualized or intensified for students with dyslexia.

Indeed, a rapid and focused effort on prevention, intervention, and careful evaluation of intervention effectiveness is greatly needed at an unprecedented time that currently lacks the needed amount of research-informed guidance. Although "basic" needs (e.g., food, water, safety from the coronavirus, suitable healthcare) are essential during a time of crisis, we argue that psychoeducational needs are equally essential and that local schools, national governments, and global agencies must do even more to provide needed and equitable supports. These supports are even more critical to students with learning difficulties and those who do not have access to equitable educational conditions (e.g., those limited by economic disadvantages).

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Valencia. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

MS-F have contributed to the conception and design of work, to interpretation of data, drafting the manuscript and revising it critically for important intellectual content, a final approval of the version to be published, and to agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. JB have contributed to analysis and interpretation of data, drafting the manuscript or revising it critically for important intellectual content, a final approval of the version to be published, and to agreement to be accountable for all aspects of the work in ensuring that questions related to the

accuracy or integrity of any part of the work are appropriately investigated and resolved. MM-S and EP-M have contributed to acquisition of data, to interpretation of data, drafting the manuscript or revising it critically for important intellectual content, a final approval of the version to be published, and to agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

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How Has the COVID-19 Crisis Affected the Academic Stress of University Students? The Role of Teachers and Students

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The effects of the COVID-19 pandemic have required substantial adjustments in terms of university teaching–learning processes. The aim of this study was to verify whether there were significant differences between the academic year of 2020 and the two preceding years in factors and symptoms and stress. A total of 642 university students (ages 18–25 years) participated by filling out validated self-reports during the months from March to August 2020. Using an ex post facto design, SEM analyses and simple and multiple ANOVAs were performed. Structural results showed that stress factors from the teaching process had a predictive value for the learning process, emotions, and academic burnout, and being a man was a factor predicting negative emotion. In a similar way, inferential results revealed no significant effect of academic year but did show an effect of gender on stress experiences during the pandemic. Aside from certain specific aspects, there was no significant global effect of the year 2020 on factors and symptoms of stress. The results showed that studying in the year of the COVID-19 outbreak did not have a significant effect on stress triggered by the teaching process. From these results, we draw implications for specific guidance interventions with university teachers and students.

Keywords: COVID-19, academic stress, achievement emotions, engagement-burnout, gender, undergraduates students, teaching–learning

INTRODUCTION

Numerous health-related studies (Cancello et al., 2020; Kaushal et al., 2020; Kannampallil et al., 2020) and research topics have been set in motion due to the recent COVID-19 pandemic. In the same way, factors of well-being and achievement emotions are making a strong appearance in psychoeducational research, particularly the consequences of stressful events, because of their

potential psychological impact on university teaching and learning processes (Salanova et al., 2005; Durand-Bush et al., 2015; Berry, 2020).

Potential Factors of Academic Stress During the Teaching–Learning Process at University

The rapid expansion of the coronavirus pandemic has disrupted life for persons, states, and institutions worldwide. Feelings of great uncertainty and anxiety have been triggered (Kowal et al., 2020; Ramos-Lira et al., 2020). This situation has posed a real challenge and a dramatic change for the university in general, and for professors and students (Kecojevic et al., 2020). Academic life was abruptly confined to the home, and the ordinary activity of the university, with its face-to-face teaching and learning, has had to be substituted by online teaching and remote learning (Sahu, 2020). With this scenario, it is reasonable to expect that university life has become even more stressful than usual for many students (Ahern and Norris, 2011; Denovan and Macaskill, 2017; Szulevicz et al., 2019; American College Health Association (ACHA), 2020; Hasan et al., 2020; Song et al., 2020). This perceived stress would then have an ongoing influence on their emotions, on how they engage in the learning process, and their psychological well-being (Capone et al., 2020; Kecojevic et al., 2020; Rodríguez-Hidalgo et al., 2020).

Prior research has identified several factors of academic stress pertaining to the teaching–learning process (de la Fuente et al., 2020c; Karaman et al., 2017), that is, factors that may provoke stress in students (de la Fuente et al., 2011). Stress factors pertaining to the *teaching process* include maladjusted teaching methodology, poor classroom climate, and irrelevant content; factors related to the *learning process* include an excess of learning activities (perceived as a heavy workload), student presentations in class, and an assessment system that induces lack of control over one's achievement (González-Cabanach et al., 2008, 2016, 2017). The specific causes of these effects, yet to be evaluated, fall within the scope of educational psychology and its study of academic stress (de la Fuente et al., 2017).

The Teaching Process as a Factor of Academic Stress

Direct and indirect changes in the academic life of universities, brought about by the COVID-19 pandemic, have attracted research interest. We are all aware of the numerous adjustments that have been made in a short period of time, transitioning from face-to-face teaching systems to distance learning or combination formats, as well as adjustments made to university syllabi, learning activities, online exams, and adaptations in class attendance. Ultimately, the COVID-19 experience has become a stress test—to borrow a concept from banking—for our university system (Hasan et al., 2020; Song et al., 2020). *Regulatory teaching* refers to a good teaching style, in that it favors a good learning process. There is ample evidence for teaching style being a predictor of student engagement, motivation, and well-being, and it is a *buffering* factor against academic stress (Codina et al., 2020; Dash et al., 2020). Teacher profile, referring to their emotions and their own motivations, has also been found to positively or negatively affect the learning process (Moè and Katz, 2020a,b; Vermote et al., 2020).

The *Self- vs Externally-Regulated Learning* (SRL vs ERL) *Theory* (2017) is a complementary perspective and a valid heuristic for analyzing this reality. Reports of previous evidence have already revealed effects in this direction, in different motivational variables (de la Fuente et al., 2017), positive and negative emotionality (de la Fuente et al., 2020b), coping strategies (de la Fuente et al., 2020a), and factors and responses to academic stress (de la Fuente et al., 2020c). Based on the theory's assumptions of regulation, nonregulation, and dysregulation (internal and external), the following types of teaching–learning contexts may be described:

1) *Regulatory teaching–learning*. This is the case where teachers have properly planned and designed the teaching–learning process, including a range of technical support that allows the process to proceed adequately and be fitted to the new situation with minimal planning changes. In this scenario, students are less likely to show stress symptoms, negative emotionality, and burnout, and motivational behaviors of engagement can be maintained.
2) *Nonregulatory teaching–learning*. In this case, where teachers have prepared only face-to-face learning without the use of online technologies, their planning is not compatible with the new situation of online teaching. Clear teaching-learning guidelines for the new situation do not exist. Students feel uncertain about the way forward, and external regulation is lacking, thus increasing the likelihood of stress symptoms, negative emotionality, and a certain degree of burnout.
3) *Dysregulatory teaching–learning*. In such cases, teachers follow an irregular pattern; previous planning is lacking, and they make arbitrary decisions about teaching and learning in the new situation. Assessment criteria undergo changes and unexpected new activities are incorporated. Consequently, students feel overwhelmed by the demands, are plagued with uncertainty and negative emotionality, and show greater levels of burnout.

Student Characteristics as a Factor of Academic Stress: Gender Differences

The potential psychological and academic impact of confinement during the COVID-19 pandemic, students' management of stress, and a possible gender modulation, among other factors, are subjects of growing interest in the most recent psychoeducational research (Ahuja et al., 2020; Cao et al., 2020; Harutyunyan et al., 2020; Rogowska et al., 2020; Rodríguez et al., 2020; Ribeiro et al., 2021). There are certain disparities in the research regarding increased academic stress during the COVID-19 outbreak (Capone et al., 2020; Rogowska et al., 2020), its repercussions on the well-being of students from different cultures (Rogowska et al., 2020) and the role of gender differences (Pomerantz et al., 2002; Harutyunyan et al., 2020; Rogowska et al., 2020). Many research studies indicate that, both in

the general population and the university population, women present higher levels of stress (Loureiro et al., 2008; Cabanach et al., 2009). In prior research reports, however, there is a lack of agreement in this regard (Matheny et al., 2008; Ahern and Norris, 2011; Rodríguez et al., 2020), so the contribution of this demographic variable requires further exploration. Among the main academic stressors that students refer to are deficiencies in teaching methodology, excessive workload, public speaking (presentations), exams, and poor social relations within the academic context.

All the foregoing aspects seem to be modulated by the gender variable, with ample supporting evidence already (Richardson and King, 1991; Davis, 1995; Sadler-Smith, 1996; Andreou et al., 2006; Else-Quest et al., 2006; Brougham et al., 2009). Recent research has shown that being a woman is associated with and is a determinant of higher anxiety levels in university students (Gao et al., 2020), but it is also associated with higher self-regulation (Duckworth and Seligman, 2006), academic behavioral confidence (de la Fuente et al., 2013a,b; Sander and de la Fuente, 2020), engagement, resilience, and academic achievement (Durand-Bush et al., 2015). Moreover, men are associated with and are a determinant of procrastination and poorer achievement (Garzón-Umerenkova et al., 2018). For these reasons, the present investigation analyzes whether this usual tendency has been intensified as a consequence of the new context we are facing.

Achievement Emotions as a Correlate of Academic Well-Being or Discomfort

Academic obstacles related to learning and teaching (or academic stress) affect one's emotionality toward academic tasks. There is plenty of recent evidence that achievement emotions are a significant correlate of academic well-being and of the degree of satisfaction with the academic experience at university (Garett et al., 2017; Frenzel et al., 2018). When this emotionality is positive, it is reasonable to infer that positive emotions exist during the process, such as enjoyment, pride, satisfaction. Negative emotions, such as boredom, anger, anxiety, or hopelessness, suggest the opposite: that there are maladjustment issues while learning (Pekrun et al., 2005; Vermunt, 2007).

Certain studies highlight differences in the associations between academic stress and academic well-being, burnout, and engagement (Extremera et al., 2007). Pekrun et al. (2002) consider that the study of affect in educational psychology should address the full range of students' affective experiences, negative as well as positive. In recent years, the control-value theory of achievement emotions (CVTAE) is being used to examine how emotions shape student engagement and learning (Linnenbrink-García and Pekrun, 2011; Kahu et al., 2015; Gelabert-Carulla and Muntaner-Mas, 2017; Burr and Dallaghan, 2019; de la Fuente et al., 2020b).

The Motivational State of Engagement Burnout in University Students

The phenomena of *burnout* and *engagement* have been analyzed profusely in the organizational context (Maslach et al., 1996), but in the past two decades they are also the object of study in the academic context (Christenson et al., 2012) and at the university level (Martínez et al., 2002; Schaufeli et al., 2002; Yang, 2004; Salanova et al., 2005; Mostert et al., 2007; Zhang et al., 2007; Casuso-Holgado, 2011; Friedman, 2014).

The stress experienced by the student is seen as an important predictor of their motivational state of burnout/engagement (Salanova et al., 2010). Differences in motivational state may depend on the subject's dispositional variables, such as self-efficacy (Salanova et al., 2011) and emotional intelligence (Durán et al., 2006), on sociodemographic variables (sex and age), and on educational variables (teaching methods and guidance) (Lekwa et al., 2018).

The motivational state of academic engagement-burnout has also been analyzed, where engagement was observed to be directly proportionate to the degree of students' self-regulation and a regulatory teaching process. Higher levels of self-regulation mean a stronger motivational state of engagement and less burnout; lower levels show the opposite (de la Fuente et al., 2017).

Aims and Hypotheses

Based on the above, the *aims* of this study were as follows: (1) to analyze whether the students' perception of teaching and learning stress factors predicted significant changes in achievement emotions and motivational state of engagement-burnout and whether the academic year and gender could also predict these emotional changes; (2) to inferentially analyze the specific causal effects that the *academic year* and *gender* had on stress factors originating in the teaching–learning process, on negative emotions, and on the state of engagement-burnout of undergraduate students.

We established the following *hypotheses*. (1) The perception of stressors in teaching will positively and significantly predict learning stressors; and these will, in turn, predict negative emotions, as well as students' state of engagement-burnout. Additionally, this relationship will be predicted by the COVID-19 academic year and by gender. (2) The *year* and *gender* factors will have a significant main effect on the level of the teaching-learning factors of stress, negative emotions, and the state of engagement-burnout. These results would be differentiated according to gender, based on prior evidence, with men showing more emotional decline toward burnout and women showing greater engagement and greater test anxiety.

MATERIALS AND METHODS

Participants

A total of 642 university students (between the ages of 18 and 25) participated in this study. Of these, 201 students participated in 2018, 168 students in 2019, and 305 in 2020. The mean age was 20.42 years (SD = 5.8), and the age range was 19–25 years. Participation was anonymous and voluntary. Lecturers from various departments were invited to participate, and those who agreed then extended the invitation to their students. Participating lecturers and students were awarded a Certificate of Participation. Online questionnaires were applied to assess each specific teaching–learning process. The groups of participating

students were different and from different academic subjects. All of them were studying for Degrees in Psychology and Education. Group equivalence was checked using the relevant statistical analyses (see section "Data Analyses").

Instruments

Factors of Stress

The Academic Stress Questionnaire, CEA/ASQ (González-Cabanach et al., 2008). First, the internal structure of the scale was analyzed. For this purpose, we used confirmatory factor analysis (CFA) with the entire data set from our sample. The default model showed good fit [chi-square or CMIN = 66.457, df = 13, $p < 0.001$; relative chi-square or CMIN/df = 5.11; SRMR = 0.075, CFI = 0.935, TLI = 0.961, IFI = 0.947, RFI = 0.965, NFI = 0.947, RMSEA = 0.057, HOELTER = 0.430 ($p < 0.05$) and 0.532 ($p < 01$)]. The proposed model contained 53 items with a seven-factor structure having two dimensions, where one factor differs from the original version. The resulting dimensions and factors were: (1) Dimension of Stress in Learning: Heavy Workload (Factor 2), Lack of Control over Achievement (F3), Social climate (Factor 5), and Test Anxiety (Factor 7); (2) Dimension of Stress in Teaching: Methodology difficulties (Factor 1), Public speaking (Factor 4); Content lacking value (Factor 6). Overall reliability, Alpha = 0.961; part 1, Alpha = 0.932, part 2, Alpha = 0.946, in this study. Some examples of items are as follows: "I get nervous or tense... when they ask me questions in class" and "It worries me. . .that the subjects we are studying are of little interest."

Achievement Emotions in the Study Situation

We measured achievement emotions with a validated Spanish version (Paoloni et al., 2014; de la Fuente, 2015a,b; Paoloni, 2015) of the Achievement Emotions Questionnaire (Pekrun et al., 2005), which had adequate reliability and construct validity values. The questionnaire was one of the outcomes of a qualitative and quantitative research program that analyzed student emotions within academic achievement situations. Several discrete emotions are measured, as they appear in the three primary situations of academic achievement: class time, study time, and doing tests and exams. Each of the three sections of the questionnaire corresponds to one of these situations, respectively. In total, 80 items in the class-related emotions scale (CRE) measure the following eight emotions as they occur during class: enjoyment, hope, pride, anger, anxiety, shame, hopelessness, and boredom. The learning-related emotions scale (LRE) contains 75 items that measure the same eight emotions in study situations. The test emotions scale (TE) measures these emotions in testing situations, using 77 items. Each of the scales contains three subscales that measure emotions appearing before, during, or after the corresponding situation under assessment. Trait achievement emotions are assessed, that is, the student's typical emotional reactions to each type of achievement situation. Instructions for the AEQ can be modified, as needed, to measure emotions experienced in a particular class subject (course-specific emotions) or in specific situations at specific moments (state achievement emotions). Example items include the following: emotions at the start of study ("I have an optimistic view toward studying"); emotions during study time ("Because I'm bored, I get tired sitting at my desk"), and emotions when finishing study ("I am so happy about the progress I made that I am motivated to continue studying"). Internal consistency of the class situation scale is good (Alpha = 0.904; Part 1, Alpha = 0.803; Part 2, Alpha = 0.853). Internal consistency of the study situation scale is adequate (Alpha = 0.939; Part 1, Alpha = 0.880, Part 2, Alpha = 0.864). Internal consistency of the testing situation scale is sufficient (Alpha = 0.913; Part 1, Alpha = 0.870, Part 2, Alpha = 0.864). Students report their own emotions according to type (positive vs. negative) and intensity (from 1 = none to 5 = very strong). Examples of items are as follows: "BEFORE STUDYING . . . I get so nervous that I don't even want to begin to study"; "DURING STUDY. . . I worry whether I'm able to cope with all my work"; and "AFTER STUDYING. . . I'm proud of myself."

Engagement Burnout

A validated Spanish version of the *Utrecht Work Engagement Scale for Students* (Schaufeli et al., 2002) was used to assess engagement in our study sample. The model obtained good fit indices in this sample. We confirmed multidimensionality of the scale and metric invariance in our samples (Chi-square = 792.526, df = 74, $p < 0.001$; CFI = 0.954, TLI = 0.976, IFI = 0.954, TLI = 0.979, and CFI = 0.973; RMSEA = 0.083; HOELTER = 153, $p < 0.05$; 170 $p < 0.01$). Cronbach alpha in this sample was.900 (14 items), with 0.856 (7 items) and 0.786 (7 items) for the two parts, respectively. A validated Spanish version of the *Burnout Scale for Students* (Schaufeli et al., 2002) was used to assess burnout. Psychometric properties for this version were satisfactory in students from Spain. The model obtained good fit indices in this sample. We confirmed multidimensionality of the scale and metric invariance in our samples (Chi Square = 767.885, df = 87, $p < 0.001$; CFI = 0.956, TLI = 0.964, IFI = 0.951, TLI = 0.951, and CFI = 0.953; RMSEA = 0.071; HOELTER = 224, $p < 0.05$; 246 $p < 0.01$). Cronbach's alpha for this sample was Alpha = 0.874 (15 items), with Part 1, Alpha = 0.853 (8 items) and Part 2, Alpha = 0.793 (7 items) for the two parts, respectively. Examples of items are as follows: "I feel happy when I am studying intensively" and "I doubt the significance of my studies."

Procedure

Researchers from the present project were asked to invite students from their university to complete the questionnaires mentioned above during the months from March to August 2020. Samples of these questionnaires had previously been collected during the same months of 2018 and 2019. We followed the same protocol that was established and approved by the ethics committee of the University of Navarra (ref. 2018.170). Questionnaires were completed online, on a voluntary basis, outside of class time. An automated tool (www.inetas.org) had been designed for this purpose (de la Fuente, 2015a,b). Both the students and the teachers involved were offered certification of their participation in the Research Project.

Data Analyses

The research design was ex post facto, non-linear, and inferential using a non-probabilistic convenience sample. To test the

hypotheses posed, we carried out previous analyses using Levene's test, in order to ensure equality of variances of errors.

1) For the *structural predictive hypotheses,* confirmatory factor analysis was tested with a Structural Equation Model (SEM) in this sample. Data were aggregated using the determination of factors obtained in the corresponding previous exploratory and confirmatory factor analyses (not summationally) in order to avoid false positives. We assessed model fit by first examining the ratio of chi-square to degrees of freedom, SRMR, then the Comparative Fit Index (CFI), Normed Fit Index (NFI), Incremental Fit Index (IFI), and Relative Fit Index (RFI). Ideally, these should all be greater than 0.90. Sample size adequacy was checked using the Hoelter Index (Tabachnick and Fidell, 2001). AMOS (v.22) was used for the latter analyses.
2) For the *inferential hypotheses,* we carried out ANOVAs and MANOVAs, 3 (year = 2018, 2019, and 2020) × 2 (gender = Men and Women), using Pillai's index. The software package SPSS v. 25 (New York) was used for these analyses.

RESULTS

Structural Prediction Model

Several models were tested in order to validate the hypothesis of the year × gender effect. *Model 1* included the effect of both variables (teaching and learning factors of stress) on positive vs. negative emotions, as well as engagement vs. burnout, but it was not considered positive. *Model 2* tested the effect of both variables (teaching and learning factors of stress) only on negative emotions and burnout, with more acceptable, but still insufficient, values. *Model 3* tested the effect of the academic variables (teaching and learning factors of stress, year, and gender) on stress factors, negative emotions, and burnout, achieving acceptable values. The values of each model are presented in **Table 1**.

Direct effects were found, showing that gender (Men = 1 and Women = 2) negatively predicted negative emotions during the study (B = –0.90). Stress factors of teaching were also found to positively predict the stress factors of learning (B = 0.943). Stress in learning positively predicted negative emotions (B = 0.692) and to a lesser degree burnout (B = 0.215). However, negative emotions while studying strongly predicted Burnout (B = 0.512). See **Table 2** and **Figure 1**.

Indirect prediction effects were of particular interest. Gender (M = 1 and F = 2) was a negative but less consistent predictor of burnout (–0.046), of negative emotions while learning, and of the factors of burnout. Stress factors in Teaching appeared as positive indirect predictors—with greater consistency—of negative emotions (B = 0.652) and burnout (B = 0.536). Finally, stress factors while learning appeared as indirect predictors of burnout (B = 0.354). See **Table 3**.

TABLE 2 | Standardized Direct Effects of prediction.

	Gender	Stress factors of Teaching	Stress factors of Learning	Negative Emotions	Burnout
Stress Teaching					
Stress Learning		0.943			
Negat. Emotions	–0.90		0.692		
Burnout			0.215	0.512	
Value cont.		0.586			
Negative climate		0.679			
Method diffic.		0.622			
Lack of control			0.912		
Public speaking			0.484		
Heavy workload			0.852		
Hopel.Study				0.926	
Shame.Study				0.846	
Boredom.Study				0.785	
Anger.Study				0.863	
Anxiety.Study				0.869	
Depletion					0.834
Cynicism					0.799
Low Efficacy					0.551

Stress Teaching = Stress factors in Teaching; Stress Learning = Stress factors in Learning); Negat. Emotions = Negative emotions while learning; Burnout = Burnout; Value cont. = Value of the content; Negative climate = negative social climate; Method diffic. = methodological difficulties; Lack of control = lack of control over achievement; Public speaking = speaking in public (presentations); Heavy workload = heavy workload; Hopel.Study = Hopelessness.Study; Shame.Study = Shame.Study; Boredom.Study = Boredom.Study; Anger.Study = Anger.Study; Anxiety.Study = Anxiety.Study; Depletion.Study = exhaustion; Cynicism = cynicism; Low Efficacy = Lack of efficacy.

Effect of Academic Year and Gender on Factors of Academic Stress

Effect of Year and Gender on Total Level of Factors of Academic Stress

The previous analyses showed an adequate level of homogeneity of variance [*Levene Test* (5,668) = 0.884, $p < 0.519$]. The ANOVA revealed a single main effect of *gender* on the level of total *stress factors,* tending toward women (that is, women showed higher levels of total academic stress factors) and no significant

TABLE 1 | Statistical values of the models tested.

Model	Chi/df $p <$	Ch/df	SRMR	NFI	RFI	IFI	TLI	CFI	RMSEA	HOELT
1.	1657.529/146***	11.353	0.15	0.884	0.796	0.855	0.811	0.855	0.082	177
2.	1560.686/145***	10.763	0.12	0.853	0.807	0.865	0.822	0.864	0.079	187
3.	666.764/100***	6.667	0.07	0.928	0.939	0.929	0.953	0.929	0.075	218

****p < .001.*

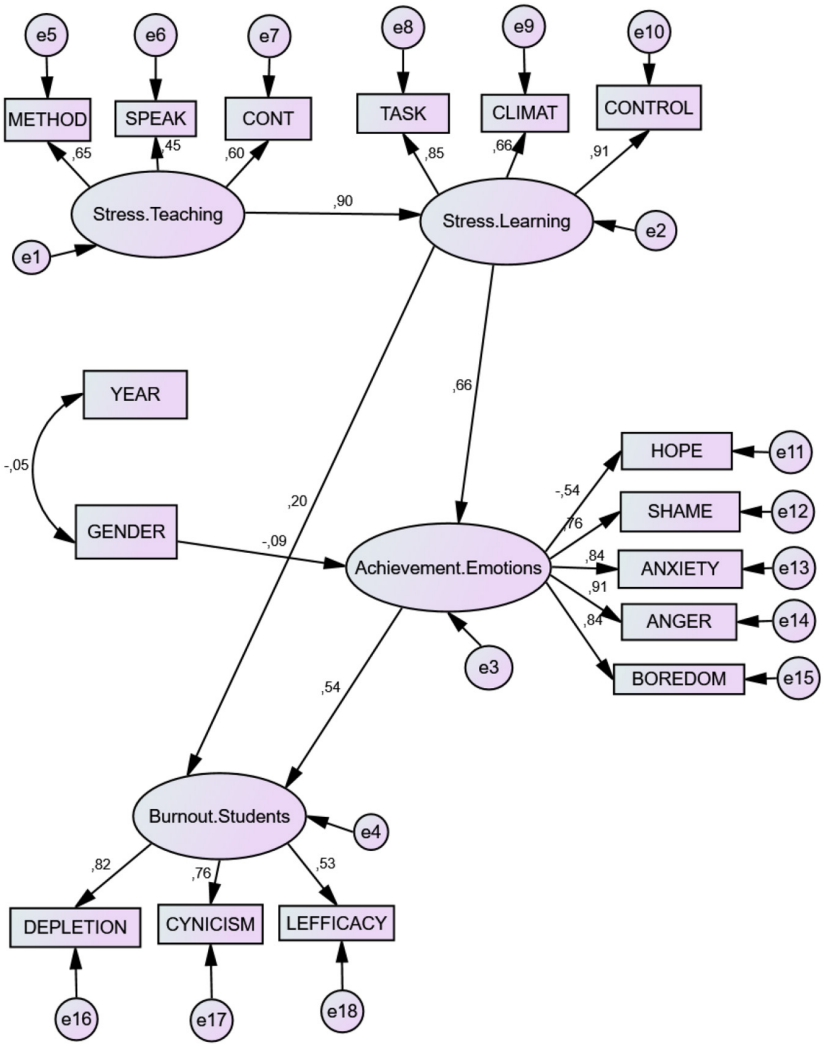

FIGURE 1 | Structural predictive model. Stress.Teaching = Stress Factors in Teaching process; Stress.Learning = Stress Factors in Learning process; Achievement.Emotions = achievement emotions during study; Burnout.Students = Burnout; METHOD = methodological difficulties; SPEAK = speaking in public; CONT = value of the content; TASK = heavy workload; CLIMAT = negative social climate; CONTROL = lack of control over achievement; HOPE = Hope.Study; ANXIETY = Anxiety.Study; ANGER = Anger.Study; SHAME = Shame.Study; BOREDOM = Boredom.Study; DEPLETION = Exhaustion; CYNICISM = cynicism; LEFFICACY = Lack of efficacy. Gender (1 = Men; 2 = Women).

interaction effect. Note that the most important effect of gender was found in stressors in the learning process. See values in **Table 4**.

Effect of Year and Gender on the Factors of Academic Stress Pertaining to the Teaching–Learning Process

The previous analyses showed an adequate level of homogeneity of variance, both for stress factors of teaching [*Levene Test* (5,637) = 1.537, $p < 0.176$] and stress factors of learning [*Levene Test* (5,637) = 0.592, $p < 0.706$]. Regarding the MANOVA, there was a single significant main effect, referring to *gender*, with a higher level of stress factors for women. The partial effects showed an effect of gender in stress factors of the *teaching process*, and of the *learning process*. Finally, there was a marginally significant interaction effect of *year x gender* for stress factors of the *learning process*. See raw descriptive values and effects in **Table 4**.

Effect of Year and Gender on Specific Stress Factors Pertaining to the Teaching–Learning Process

The previous analyses showed an adequate level of homogeneity of variance, both for stress factors of teaching [*Levene Test* (5,637) = 1,537, $p < 0.176$] and stress factors of learning [*Levene Test*(5,637) = 0.592, $p < 0.706$]. Regarding the MANOVA, there was a single significant main effect referring to *gender,* with a higher level of specific stress factors for women. The partial effects showed an effect of *gender* on the following stress factors: in the teaching process, these were *methodological difficulties*

and *heavy workload* (this factor with higher power), and in the learning process, these were *public speaking* and *lack of control over achievement*. Finally, there were two, marginally significant, *year x gender* interaction effects, for stress factors of the teaching process: *heavy workload* and *public speaking*. See the descriptive values and effects in **Table 4**.

Effect of Academic Year and Gender on Achievement Emotions

Effect on Total Positive and Negative Emotions During Study

The Levene test, based on the mean, showed an absence of significant differences in errors of variance, for both positive emotions [*Levene test* (5,665) = 0.911; $p < 0.437$] and negative emotions [*Levene Test* (5,665) = 0.527; $p < 0.756$]. There was no significant main or partial effect of year, gender, or year × gender on total achievement emotions during study.

Effect on Specific Positive and Negative Emotions During Study

The Levene test, based on the mean, showed an absence of significant differences in errors of variance, for all dependent variables analyzed. There was a significant main effect of *gender* on total achievement emotions. The partial effects showed an effect of gender on the emotion of boredom, tending toward men, and academic *year x gender* interaction on the response to anxiety, tending toward women. See **Table 4**.

Effect of Academic Year and Gender on Engagement-Burnout

The analyses of the variance of error revealed no significant differences, whether for *Engagement* [Levene test (5.745) = 0.838, $p < 0.523$)] or *burnout* [Levene test (5.745) = 0.168, $p < 0.974$)]. The MANOVA revealed a significant main effect of *gender* on total engagement-burnout—an effect that was partially maintained for each total score of the motivational states, *engagement* (in favor of women), and *burnout* (in favor of men).

A significant main effect of *gender* also appeared in the set of all engagement-burnout factors. The partial effects showed a significant partial effect of gender on *cynicism*, tending toward men, as well as effects on *dedication* and *absorption,* tending toward women. Raw values are shown in **Table 4**.

TABLE 3 | Standardized Indirect Effects of prediction.

	Gender	Stress factors of Teaching	Stress factors of Learning	Negative Emotions	Burnout
Stress Teaching					
Stress Learning					
Negat. Emotions		0.652			
Burnout	–0.046	0.536	0.354		
Value cont.					
Negative climate					
Method diffic.					
Lack of control		0.860			
Public speaking		0.456			
Heavy workload		0.804			
Hopel.Study	–0.083	0.604	0.640		
Shame.Study	–0.076	0.552	0.585		
Boredom.Study	–0.071	0.512	0.543		
Anger.Study	–0.078	0.563	0.597		
Anxiety.Study	–0.078	0.567	0.601		
Depletion	–0.038	0.447	0.474	0.427	
Cynicism	–0.037	0.428	0.454	0.409	
Low Efficacy	–0.025	0.295	0.313	0.282	

Stress Teaching = Stress factors in Teaching; Stress Learning = Stress factors in Learning); Negat. Emotions = Negative emotions while learning; Burnout = Burnout; Value cont. = Value of the content; Negative climate = negative social climate; Method diffic. = methodological difficulties; Lack of control = lack of control over achievement; Public speaking = speaking in public (presentations); Heavy workload = heavy workload; Hopel.Study = Hopelessness.Study; Shame.Study = Shame.Study; Boredom.Study = Boredom.Study; Anger.Study = Anger.Study; Anxiety.Study = Anxiety.Study; Depletion.Study = exhaustion; Cynicism = cynicism; Low Efficacy = Lack of efficacy.

DISCUSSION

The *first aim* of the present research specifically examines the predictive effect between university students' perception of academic stress (induced from the teaching and learning process), achievement emotions, and motivational state of engagement-burnout during the period of the COVID-19 outbreak and in the two previous academic years, taking into account gender differences (*Hypothesis 1*).

In this case, the hypotheses were partially fulfilled. Firstly, consistent positive predictive relationships were found between stress factors during the teaching process (methodological difficulties, and the lack of content value, mainly) and stress factors in the learning process (excess of activities and lack of control over achievement, mainly). In turn, these variables predicted the absence of positive emotions and the presence of negative emotions, as well as academic burnout. These initial results are intrinsically interesting because they show the potential stressful effect that the teaching process had on the learning process. Research on teaching styles has shown that teaching style can be a stress inducer (Dash et al., 2020). This evidence also provides empirical support for the hypothetical relationship between the stress factors that arise from the teaching process, and their effect on learning. A higher perceived level of academic stress (greater negative emotionality and level of burnout) in the learning process is thereby shown to be predicted by greater factors of stress in the teaching process (Moè and Katz, 2020a,b). By contrast, concerning the predictive value of the academic year, it was found that despite the COVID-19 outbreak, no statistical effect was found supporting such relationships. Therefore, the academic year was not a predictor of changes in the factors investigated. This invariance of results could be explained by a continuity in the teaching style of lecturers, which seems to have operated as a protective factor buffering against the experience of stress during the COVID-19 pandemic (Codina et al., 2020). However, gender significantly predicted

TABLE 4 | Descriptive values of the different levels of Stress Factors: M(SD) (n = 674).

Year	**2018**			**2019**			**2020**				
Gender	**M**	**F**	**T**	**M**	**F**	**T**	**M**	**F**	**T**		
(n =)	**(39)**	**(162)**	**(201)**	**(47)**	**(121)**	**(168)**	**(72)**	**(233)**	**(305)**	**Effects, *F* (Pillais test)**	**Post**
Total stress	2.85(0.67)	2.94(0.70)	2.29(0.69)	2.81(0.76)	3.07(0.67)	3.00(0.70)	2.76(0.63)	3.11(0.66)	3.03(0.67)	G, $F(1,668) = 13.089^{***}$, $r^2 = 0.019$, *power* = 0.91	F > M
Teaching stress	2.80(0.67)	2.88(0.73)	2.86(0.71)	2.85(0.84)	3.05(0.73)	3.00(0.77)	2.77(0.62)	3.03(0.70)	2.97(0.70)	G, $F(2,636) = 7.949^{***}$, $r^2 = 0.024$; *power* = 0.995; G, $F(1,637) = 6.538^{**}$, $r^2 = 0.010$; *power* = 0.72	F > M
Learning Stress	2.84(0.82)	2.94(0.78)	2.92(0.79)	2.72(0.85)	3.01(0.72)	2.97(0.73)	2.64(0.74)	3.13(0.74)	3.02(0.77)	G, $F(1,636) = 15.923^{***}$, $r^2 = 0.024$; *power* = 0.979; YxG, $F(2,637) = 2.536$, $p < 0.08$, $r^2 = 0.008$; *power* = 0.508	F > M
Methodology Difficulties	3.35(0.73)	3.49(0.80)	3.46(0.79)	2.39(0.88)	3.52(0.89)	3.48(0.88)	3.31(0.79)	3.56(0.87)	3.56(0.84)	G, $F(6,632) = 3{,}478^{***}$, $r^2 = 0.032$; *power* = 0.948; G, $F(1,637) = 7.349^{**}$, $r^2 = 0.011$; *power* = 0.742	F > M
Heavy Workload	2.72(0.83)	2.84(0.90)	2.82(0.89)	2.81(0.96)	2.97(0.82)	2.92(0.96)	2.67(3.19)	3.19(0.88)	3.07(0.97)	G, $F(1,637) = 10{,}050^{***}$, $r^2 = 0.016$; *power* = 0.886; Y x G, $F(2,637) = 2.678$, $p < 0.06$, $r^2 = 0.008$; *power* = 0.571	F > M
Public speaking	3.22(1.15)	3.28(1.07)	3.27(1.09)	3.32(1.17)	3.17(1.22)	3.22(1.20)	2.68(1.17)	3.41(1.16)	3.23(1.20)	G, $F(1,637) = 16.456^{***}$, $r^2 = 0.025$; *power* = 0.482; Y x G, $F(2,637) = 2.548$, $p < 0.07$, $r^2 = 0.008$; *power* = 0.510	F > M
Lack of control over achievement	2.57(0.83)	2.66(0.81)	2.65(0.82)	2.54(0.91)	2.68(0.71)	2.64(0.72)	2.45(0.72)	2.74(0.80)	2.67(0.79)	G, $F(1,637) = 4.991^{***}$, $r^2 = 0.008$; *power* = 0.607	F > M
Achievement Emotions										G, $F(8,658) = 3.965^{***}$, $r^2 = 0.046$; *power* = 0.992	
Boredom in Study	2.48(0.83)	2.31(0.82)	2.34(0.83)	2.50(0.99)	2.16(0.89)	2.27(0.94)	2.35(0.83)	2.14(0.88)	2.19(0.87)	G, $F(1,665) = 8.572^{***}$, $r^2 = 0.013$; *power* = 0.832	M > F
Anxiety in Study	2.47(0.74)	2.66(0.72)	2.62(0.73)	2.59(0.74)	2.40(0.74)	2.46(0.74)	2.41(0.75)	2.55(0.71)	2.51(0.72)	Y x G, $F(1,665) = 3.348^{*}$, $r^2 = 0.010$; power = 0.632	F > M
Engagement-Burnout										G, $F(2,766) = 4.841^{***}$, $r^2 = 0.012$; *power* = 0.800	
Engagement	3.14(0.75)	3.42(0.68)	3.37(0.70)	3.18(0.65)	3.43(0.76)	3.31(0.71)	3.24(0.70)	3.40(0.74)	3.26(0.76)	G, $F(1,777) = 9{,}333^{***}$, $r^2 = 0.012$; *power* = 0.862	F > M
Burnout	2.50(0.68)	2.34(0.75)	2.39(0.68)	2.51(0.69)	2.24(0.65)	2.31(0.62)	2.39(0.68)	2.37(0.67)	2.37(0.69)	G, $F(1,777) = 6{,}140^{***}$, $r^2 = 0.008$; *power* = 0.697	M > F
Factors										G, $F(6,772) = 3.698^{***}$, $r^2 = 0.028$; *power* = 0.961	
Cynicism	2.38(0.92)	2.18(0.90)	2.21(0.90)	2.28(1.00)	2.14(0.99)	2.19(1.10)	2.53(0.88)	2.24(0.94)	2.32(0.94)	G, $F(1,777) = 11.401^{***}$, $r^2 = 0.014$; *power* = 0.921	M > F
Dedication	3.71(0.77)	3.81(0.68)	3.79(0.70)	3.69(0.87)	3.79(0.83)	3.76(0.84)	3.54(0.84)	3.85(0.81)	3.76(0.83)	G, $F(1,777) = 5{,}285^{*}$, $r^2 = 0.012$; *power* = 0.800	F > M
Absorption	2.97(0.92)	3.27(0.83)	3.21(0.85)	2.92(0.70)	3.18(0.95)	3.11(0.92)	3.14(0.88)	3.08(.099)	3.09(0.96)	G, $F(1,777) = 4.052^{*}$, $r^2 = 0.005$; *power* = 0.520	F > M

G = Gender effect; Y = Year effect; Y x G = Year x Gender effect.
$^{***}p < 0.001$.
$^{**}p < 0.01$.
$^{*}p < 0.05$.

differences in positive and negative emotionality as well as in engagement burnout.

The *second aim* was fulfilled because the inferential results corroborated, in greater detail, the initial predictive analysis. Hypothesis 2 was partially fulfilled since the year examined (COVID-19 context) did not have a sufficiently significant impact on the variables, while the gender factor appeared to show significant statistical power to determine the value of the dependent variables analyzed. First, although there was no significant general effect of academic year (during the COVID-19 outbreak), a significant increase in certain stress factors of teaching appeared during the year 2020 (COVID-19 context), such as methodological difficulties and heavy workload. Although this effect has been less analyzed, it was to be expected, concurring with other prior evidence in mental health contexts (Chi et al., 2020). However, the greatest statistical effect was from gender, with such strength that it minimized the effect of the context year that we were analyzing.

Teaching Style as a Modulator of Students' Emotions and Academic Stress at University

Derived from the general theoretical model of SRL vs ERL (de la Fuente, 2017), characteristics of teaching are of interest, given that the teacher's regulatory capacity (external regulation) comes into play in making the necessary adjustments within the COVID-19 situation. Remember that *regulatory teaching* (as effective teaching) is designed in a way that clearly and precisely selects and establishes the times, learning activities, content, technology resources, demands, and assessment systems in order to help students learn in a regulated manner (Roehrig et al., 2012), similar to an *effective teaching style,* as highlighted within the framework of *Self-Determination Theory* (SDT; Ryan and Deci, 2000, 2016; Codina et al., 2020; Dash et al., 2020). In short, this is the kind of teaching that minimizes stress factors, while *nonregulatory or dysregulatory teaching* is teaching that contributes to an increase in such stress factors. Consequently, it can be inferred that an increase in stress factors in the teaching and learning process would be a correlate of nonregulatory or dysregulatory teaching (de la Fuente et al., 2020e). This effect can be produced in a generalized way or in specific factors. In our study, a small increase in specific stress factors characteristic of *teaching methodology difficulties* and *heavy workload* was demonstrated. Concerning stress factors that originated in the teaching process, our results indicate that:

(1) Certain specific decisions in the teaching process were probably hasty and inadequate, causing distress and concern in the students; they did not fit into the design of the original subject syllabus and led to a perceived loss of control, an aspect that tends toward student stress (Goe et al., 2008; González-Cabanach et al., 2016, 2018). Previous research has demonstrated students' emotional dependence on the teaching process and on interaction with the teacher (Mainhard et al., 2018);
(2) However, these mismatches were not determined by the academic year, rather, determinants of negative academic emotions and the state of burnout were stable despite COVID-19. For this reason, we argue that the teachers' teaching styles remain stable despite the pandemic and seem to operate as a protective factor against stress (Codina et al., 2020; Dash et al., 2020).

Stress factors that emerge from the *learning process* are indirectly triggered through the teaching process (a predictive aspect that has been shown in the results) but are also triggered directly by the student. Prior evidence has shown that the student's level of regulation determines their stress factors while learning (de la Fuente et al., 2020a). Therefore, student levels of nonregulation and dysregulation would be accompanied by higher levels of stress factors while learning, thereby explaining the increase in the negative emotions of *boredom* in men (Goetz et al., 2014). In this case, there could be an increase in the stress factor of perceived loss of control over achievement (Cole and Sapp, 1988). Although this study did not test the level of regulation—neither general regulation nor regulated learning—certain difficulties or stress factors can be attributed to a lack of student regulation when facing this new situation (Wolff et al., 2020).

In this research, these are factors that directly cause negative academic emotions or burnout. According to Maslach and collaborators (Maslach and Jackson, 1981; Maslach and Leiter, 1997), the concept of *burnout* (Schaufeli et al., 2002; Schaufeli and Bakker, 2004; Salanova et al., 2010) has a three-dimensional structure with the components of exhaustion, cynicism, and loss of self-efficacy or competence. In line with the results found here, students with burnout were unable to adapt to situations of contextual stress, producing in them a sense of lack of energy (exhaustion), loss of interest in and value given to study (cynicism), and increased doubts about their capacity as students (loss or lack of efficacy). The negative repercussions of this syndrome on students' health, learning, and well-being have been corroborated (Schaufeli et al., 2002).

However, the effect on engagement was minimal and very inconsistent. Given the influence from positive psychology (Seligman and Csikszentmihalyi, 2000) and interest in studying positive aspects of individuals as opposed to dysfunctional states, the present topic has been approached from a focus on the conceptual opposite of burnout, namely, engagement (Salanova et al., 2000; Maslach et al., 2001; Salanova, 2003; Schaufeli and Bakker, 2004; Kim et al., 2009). Engagement is a persistent positive, affective, and motivational state characterized by three dimensions: vigor, dedication, and absorption. Vigor, in contrast to exhaustion, involves a high level of energy and effort in the face of difficulties and setbacks. Dedication, in contrast to cynicism, is characterized by a high level of involvement and enthusiasm about the task; and absorption, as opposed to feelings of inadequacy, is associated with feelings of happiness and a high level of concentration on the task. Studies on engagement in the university setting and in the Spanish geographical context are few; more extensive work has been done in the United States, Canada, and Australia (Casuso-Holgado, 2011; Kahu, 2013; Maroco et al., 2016). As opposed to burnout, engagement is considered an indicator of subjective well-being, greater satisfaction, and lesser

tendency toward dropout (2007; Salanova et al., 2005; Zhang et al., 2007; Maroco et al., 2016; Zhang and McNamara, 2018).

Student Gender as a Modulator of Emotions and Academic Stress at University

As repeatedly presented in the results, students who identified as women scored higher on certain stress factors that were typical of inconsistencies in the teaching process but not due to dysregulatory changes in the academic year of the COVID-19 outbreak. This occurs both in partial factors of the *teaching process* (methodological difficulties, heavy workload) and in the *learning process* (loss of control over achievement). Women had higher scores in anxiety, which is consistent with prior evidence reporting gender differences in response to academic stress (Wilson et al., 1996; Giota and Gustafsson, 2020). Nonetheless, this explanation must be qualified because it is possible to make a case for the resilience of women (Yu and Chae, 2020) and greater self-regulation (Weis et al., 2013). Previous research has shown that women made greater use of problem-focused coping strategies, and men used more emotion-focused strategies (de la Fuente et al., 2013a,b). In other words, their greater engagement with the teaching–learning process made them follow its demands more closely and be more sensitive to changes therein, especially if there were real incongruencies. Levels of students' personal self-regulation have also been shown to be predicted by contexts lacking regulation (nonregulation or dysregulation) (de la Fuente et al., 2009). This is consistent with the women's higher scores in *dedication* to task (a correlate of engagement) in the present pandemic situation, which could be interpreted as a higher level of self-regulation and desire to manage the incongruencies that the pandemic has brought about (Pomerantz et al., 2002). In conclusion, the response pattern of women is that of greater perception of specific stress factors in teaching and learning and a higher negative emotion of anxiety, but the pattern also revealed a greater persistence in terms of tasks, which is a behavior typical of engagement. The results of this study shed light on how the gender variable affects the relationship patterns between stress, burnout, and engagement, as the effects found previously have not been clear and results were contradictory. In some studies, men obtained higher scores than women in cynicism (Grau et al., 2000). Regarding engagement, certain studies reported that women showed higher levels in its three dimensions (Martínez and Salanova, 2003). Others underscore differences in dedication but not absorption (Durán et al., 2006), and there are studies where differences do not appear at all (Casuso-Holgado, 2011).

In the case of men, it is notable that all scores decreased. This drop is consistent with the increase in men's negative emotions of boredom (deactivating emotion) and in the motivational state of cynicism, a typical burnout behavior (Wolff and Martarelli, 2020). Prior research has consistently shown that the emotions of enjoyment and boredom are inversely proportionate and inversely predict achievement, with boredom predicting poorer performance (Pekrun et al., 2010; Putwain et al., 2017; Obergriesser and Stoeger, 2020; Sharp et al., 2020). Consequently, boredom and cynicism seem to jointly reflect a manner of facing the situation with a lack of engagement, with passive avoidance or disconnection, thus leading to poorer performance and eventually to drop out from the teaching–learning process. We may therefore conclude that the incongruencies that characterize the COVID-19 context affect men in a different pattern, through loss of connection to the teaching–learning processes, manifest as a negative emotional state and avoidance motivation (Leonard et al., 2020; Pouratashi and Zamani, 2020). On the other hand, self-regulation and boredom have been shown to be inversely related, since a high level of self-regulation is associated with a low propensity to boredom (Isacescu et al., 2017; van Tilburg and Igou, 2017; Bieleke et al., 2020; Wolff et al., 2020). Moreover, boredom seems to be related to cognitive problems, and to physical and emotional self-regulation (Isacescu et al., 2017; Wolff et al., 2020). While high self-regulation is linked quite consistently with positive outcomes, a propensity to boredom is related mainly to negative outcomes (Eastwood et al., 2012).

From a complementary perspective, prior studies have found that the negative deactivating emotion of boredom has greater weight in class and study situations, while the positive deactivating emotion of relief is more relevant in exam situations. However, the relationship persists across class, study, and exam situations, revealing stability in the students' emotional responses, according to their learning approaches: negative emotions are typical of surface approaches to learning, while positive emotions are typical of deep approaches (de la Fuente et al., 2020d,e). This would confer a personalistic component to learning approaches, that is, a stable motivational-affective, personal style (Zhang, 2003).

Limitations and Future Lines of Research

One limitation of this study refers to the research methodology used, given that an ex post facto design itself limits the inferences that can be drawn. In addition, since we could not ensure that the academic subjects were the same ones each year, we cannot infer that methodological changes were owing exclusively to the COVID-19 crisis. Academic subjects were not grouped a priori according to regulatory, nonregulatory, or dysregulatory teaching systems, something which would have made it possible to attribute a cause to this factor, nor were students categorized as practicing self-regulated, nonregulated, or dysregulated learning. Nonetheless, recent research has documented this (de la Fuente et al., 2019, 2020d,e). Future research should clarify these aspects, given that the pandemic continues to persist, and we will have the opportunity to analyze these variables. Other specific explanatory behaviors, such as rumination, were outside the scope of this study (Shaw et al., 2017; Kamijo and Yukawa, 2018).

Predictive and explanatory analysis of how different sources of stress affect academic emotions, and how these relate to the motivational states of burnout-engagement, has particular relevance for higher education institutions. Also significant is the role of gender as a modulating variable in the development of different stress profiles at university. This analysis can help

identify which stressors in the teaching and learning process may affect university students' stress levels and, consequently, how to reduce these levels (Cotton et al., 2002; Ketonena et al., 2019) and ensure a greater degree of academic success, student well-being, and lower dropout rates. However, these results should be viewed with caution, due to the gender ratio in the sample studied. Future studies could consider a few performance indexes (marks, exams passed, dropout rates, etc.) and teaching styles, in order to better contextualize these results. Because stress is the result of a relationship between the subject and their environment (Lazarus and Folkman, 1984), the present study has stressed the important role of regulatory teaching (Lekwa et al., 2018; de la Fuente et al., 2019, 2020a,c) within the relationship framework we examine.

Implications for Psychoeducational Intervention

There are several implications for psychoeducational intervention. On one hand, teachers need to be trained in regulatory teaching processes; lack of regulation and improvised changes in activities and/or assessment during the teaching–learning process become stress factors for students (Freire et al., 2018). On the other hand, university students must be trained in self-regulated learning behaviors and made aware of the pitfalls of a lack of regulation or dysregulation in one's own learning, especially in the case of younger men (Rubin et al., 2018).

It also seems reasonable to train students in stress management competencies for learning at university, given that unforeseen events can easily appear, as in the present situation. We should not assume that nothing will happen in the future; based on experience, it is possible that unexpected life events or academic incidents will occur, and we should be prepared to take them on in a resilient manner (Pozos-Radillo et al., 2014). It is the nature of life itself. In fact, prestigious universities and colleges in the US include the promotion of Physical and Psychological Health (avoiding unhealthy behaviors, having effective coping strategies for dealing with stress) in their educational objectives and mission statements (Oswald et al., 2004; Lipnevich et al., 2016). We also find a model to follow in certain Canadian universities, where a new line of research positions learning in the context of well-being (World Health Organization, 1986). Therefore, interventions to reduce burnout (and consequently dropout rates) should target emotions and emotion regulation.

Current events are forcing us to make broad behavioral adjustments in the organization of our personal, family, and academic life for the weeks ahead. To make these adjustments smoothly, we must keep in mind different behavioral principles and strategies for coping with the pandemic, something which is under-addressed in university Study Plans at every level. It is essential to design programs and improvement strategies for competency in dealing with the pandemic, from a psychological viewpoint (Robert, 2020) and from a psychoeducational viewpoint specifically. Some of these adjustment principles have already been formulated (de la Fuente et al., 2021). An example of specific strategies—already listed in another research report—include the following (de la Fuente, 2020):

On the Part of Teachers

(1) In the subjects you teach, maintain a *regulatory environmental design* that prompts a perception of control and continuity in students:

   a. Keep your usual contact hours with students, using appropriate technology media. Direct, online classes allow you to continue with the subject and lessen anxiety in the students.
   b. Make every adjustment so that all participants perceive normality and a sense of control. It is best to keep up the normal pace of the subject, although with adjustments as the situation requires. It is not a good time to make big, unexpected changes.
   c. If needed, adjust your assessment system and activities during this period. Make students aware that new situations involve new behavioral challenges and opportunities, for example, the chance to practice online teamwork from home.

(2) *Apply external regulation* to help students in their learning process:

   a. In case you have not already done so, this is a good time to convert all learning resources to digital formats and encourage students to learn autonomously from home. Keep this material and instructions well-structured because students are dealing with several modules at the same time.
   b. Plan regular, general messages and aids for your students, so they feel that the teaching–learning process continues with some normality.
   c. Offer personalized online consultation for students who need it. It is especially important to keep direct contact with the student representative in each class in order to be informed of any possible problems or help that students are needing.
   d. Regularly reevaluate whether students need adjustments to the material, assignments, etc.
   e. Pay attention to the emotional state and expectations of your students. Convey calm and assurance with your own behavior. Your students see themselves reflected in you, and in the image that you portray when interacting with them. Become a mentor that supports the process, also emotionally.

On the Part of Students

(1) *Self-regulate your own behavior*: while homebound, stick to your usual schedule.

   a. Following Circadian rhythm and keeping up personal habits go far to help maintain one's sequence of activity, self-regulate, and not lose motivation.

b. Give yourself daily doses of positive emotions and rewarding experiences while sheltering at home. It is very important to keep a positive emotional frame of mind. Distress (diffuse, negative emotionality, and discouragement) can be triggered by abrupt changes in one's daily rhythm, or by a sense of uncertainty and loss of behavioral control.

1. *Self-regulate your learning behavior* during this period:

a. Every day, plan objectives, schedules, and action steps, being flexible but also systematic.
b. Exercise control over your behavior. Structure your continuous work time to include pauses for rest. Stop and take time for leisure activities (a substitute for outdoor activities). Tell yourself that you are doing the right thing. Use different relaxation techniques to decrease any anxiety.
c. It is not a good time to take on complex issues in your life situation, because this may cause even greater stress and loss of situational control. If it is truly necessary, make small, gradual adjustments.
d. Take advantage to catch up on matters that are pending, whether personal, family-related, or academic tasks. This is a gift of time.
e. Reevaluate your daily behavior at the end of the day and redefine your objectives (family-related, personal, and academic) for the next few days.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Universidad de Navarra. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JF: project IP, design, data analysis and initial writing. MP-B: bibliographic and text review. FS: data collection and review of the English text. MG-T, RA-G, FP-S, PP, and MG: data collection and final text review. All authors contributed to the article and approved the submitted version.

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ORIGINAL RESEARCH
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What Type of Social Support Is Important for Student Resilience During COVID-19? A Latent Profile Analysis

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In the face of the sudden outbreak of coronavirus 2019 (COVID-19), some students showed resilience in coping with difficulties while some did not. While different types of students showed different levels of resilience, are there significant characteristics among students with similar levels of resilience? In this study, 3,454 students (aged 15–25 years) were surveyed to understand students' perceived social support-coping modes while investigating the demographic characteristics and mental health status of subclasses of different modes. We found that (1) in the two subgroups of students with extremely low and low levels of perceived social support, the source of students' perceived social support did not have a clear orientation; in the two subgroups with moderate and high levels of perceived social support, the most perceived emotional support was from family and friends, while the least perceived support was companionship from teachers, classmates, and relatives, and problems related to the dependability of friends and communication with family. (2) The degree of social support perceived by students is directly proportional to the coping tendency, i.e., as the degree of perceived social support increases, the proportion of students adopting active coping strategies increases while that of students adopting negative coping strategies decreases; thus, we concluded that high levels of emotional support from family and friends can increase students' tendency of adopting positive strategies to cope with difficulties, while problems related to the dependability of friends and communication with family decrease students' tendency of adopting positive coping strategies. (3) Gender had a significant impact on the extremely low and low levels of perceived social support-negative coping tendencies; these subgroups accounted for 34.6% of the total students. Gender showed no significant influence on other subgroups, a school type had no impact on the distribution of the subgroups. (4) The higher the degree of perceived social support, the lower is the degree of students' general anxiety, and the lower is the degree of impact by the COVID-19 pandemic. The subdivision of student groups allows us to design more targeted support programmes for students with different psychological characteristics to help them alleviate stress during the COVID-19 epidemic.

Keywords: social support, student resilience, coping style, latent profile analysis, mental health

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INTRODUCTION

Due to the sudden outbreak of coronavirus 2019 (COVID-19), comprehensive social distancing measures were widely adopted, and students had to shelter in place at home. Facing stress caused by various difficulties, some students showed resilience, such as adopting active countermeasures as well as a more stable psychological state to deal with the crisis, while some students did not. Based on social support theory, this study aims to explore the impact of social support on students' resilience. Specifically, this study will discriminate the different perceived levels of social support among students and its impacts on students' coping tendency, and then further investigate the effect of social support-coping mode on students' mental health. The results of previous social support theory-related studies show that social support, as an important environmental resource for individuals in social life, is closely related to the control and prevention of negative emotions; good social support can provide protection for individuals under stress and has a generally beneficial effect on maintaining the health and stabilizing the mood of individuals (Martín-Albo et al., 2015; Hou et al., 2020). The same stressful situation can have different impacts on different individuals (Guay et al., 2013). Generally, those who receive more support from family or friends have a stronger mental capacity and are more mentally and physically healthy (Seiffge-Krenke and Pakalniskiene, 2011; Cao et al., 2020); in contrast, those who rarely receive similar support have a low mental capacity and poor mental and physical health (Elmer et al., 2020; Li et al., 2020). In other words, an individual's social relationship background had positive effects on his/her resistance, mitigation as well as prevention, and had a beneficial bearing on his/her health (Haber et al., 2007; Stenling et al., 2015; Labrague et al., 2020).

Social support refers to the care and support people feel from others (Raschke, 1977). Based on the perspective of interpersonal relationships, social support can be divided into four categories: emotional support refers to providing others with empathy, warmth, love, and trust; instrumental support refers to providing material help and services when others are in need; informational support refers to helping others solve problems by providing useful suggestions, information, etc.; and appraisal support refers to providing useful information for others' self-evaluation (House et al., 1988; Taylor et al., 2007). Haber et al. (2007) hold that social support is a broad term encompassing a variety of constructs but it can be divided into two types: (1) objective and visible support, including material support, network support (stable social relationships such as marriage, colleagues, friends, etc., as well as unstable social contacts such as informal groups, etc.), which is not dependent on an individual's perception and thus an objective reality, and (2) subjective support, i.e., emotional support and feelings of respect and understanding by an individual in social life, which are closely related to the individual's subjective feelings. Therefore, social support can be viewed as subjective support through various social relationships based on the social network of an individual or its objective impact on the individual. By helping an individual cope with and recover from difficult situations and adversity and improving an individual's positive mental state, social support plays a critical role in an individual's mental resilience (Cao et al., 2020; Yildirim and Tanriverdi, 2020). Studies have shown that peer support, which is the interpersonal connections among age-matched individuals established in common activities and mutual cooperation, is an important source of social support for college students (Lamis et al., 2016; Burns et al., 2020). When an individual is under pressure or feeling threatened, these connections provide an individual moral and material resources to help the individual relieve stress, reduce stress-induced negative emotions, and thus become an important factor affecting the individual's adaptation to the adverse situation. For college students who are away from families, schoolmates, friends, and other peers may be the most trustworthy members of their social networks and a particularly important source of social support. Studies have also shown that family support can effectively help students cope with difficult situations, reduce mental stress, and prevent mental health problems, thereby maintaining their mental health development (Chang et al., 2020). Certainly, other sources of social support, such as relatives, teachers, etc., can also have a general beneficial effect on the intention of students' risk taking as well as their physical and mental health improvement (Liu et al., 2019; Zhou, 2020).

Previous studies of college students' social support have addressed students' demographic characteristics and the effect of social support on an individual's mental health problems, e.g., the degree of social support obtained by male students is significantly higher than that by female students (Elmer et al., 2020), and the mental health effects of social support are directly correlated with the personality characteristics of the supported person (Liu et al., 2020). Regardless of findings, these studies overlook the internal heterogeneity of college students when perceiving social support. According to positive psychology, in particular studies on psychological resilience, relative to differences between different groups, the differences in the mental health of individuals in disadvantaged situations are more worthy of attention. Friborg et al. (2006) found that individuals with high levels of psychological resilience perceive less mental distress and show higher levels of mental health than those with low levels of psychological resilience and that psychological resilience has a moderating effect on stress and mental distress (Friborg et al., 2006; Ratelle et al., 2013). Therefore, understanding the heterogeneity within groups of students who perceive social support and adopt corresponding coping strategies differently allow distinguishing the effects of different sources of social support on students when coping with difficulties. On this basis, the in-depth investigation of subgroups of different modes can be conducted to formulate more effective and more targeted programmes to help students through the COVID-19 pandemic and similar difficulties. In this study, we examined students' social support perception-coping tendencies by subdividing the coping tendency heterogeneity on the basis of perceived social support and demographic characteristics of student subgroups with various perception-coping categories and their mental health status.

In recent years, latent profile analysis (LPA) has been widely applied for the classification of heterogeneous groups in many

fields such as sociology, biomedicine, and psychology. It can be used to simulate the likelihood (i.e., probability) that an individual belongs to a personality profile (Wang and Hanges, 2011), i.e., with the highest intragroup similarity within a subgroup and the lowest similarity in different subgroups, enabling the examination of students' perceived social support-coping strategies more accurately while providing criteria to help investigators determine the best solutions. Researchers can identify unobserved heterogeneity in LPA sample data through modeling (Meyer and Morin, 2016; Morin et al., 2016; Wang et al., 2016). After determining the solution for a profile, it is possible to predict the members of a profile using antecedent variables, i.e., if a high/low measurement for a member for one antecedent variable increases or decreases perception, the member may belong to a specific profile aspect (Vermunt, 2010; Gabriel et al., 2015).

Built on the previous researches and methodologies, in this study, we conducted LPA based on three common forms of social support to understand the overall perceived social support model of the participants and then divided the participants into two subgroups (tendency of adopting positive coping strategies and tendency of adopting negative coping strategies) to construct an LPA model to classify subgroups in terms of perceived social support-coping tendencies; furthermore, we examined the coping strategies of secondary technical school students and college students under each social support mode during the COVID-19 pandemic and the major demographic characteristics of the students. By taking full account of the internal heterogeneity within a subgroup, using LPA, we further investigated various internal problems (e.g., anxiety and stress-induced trauma) related to different perceived social support-coping tendencies and their differences.

MATERIALS AND METHODS

Participants

We conducted an online questionnaire survey of students, recruited using the cluster sampling method, from four campuses of a vocational school in Shantou City, China. Before sampling, we obtained the school's support, and each participant signed an informed consent form prior to beginning the questionnaire; we asked the psychological counseling center of the school to issue the questionnaire. The survey was conducted from February 2–6, 2020, during which 5,021 questionnaires were collected, from which 3,454 valid samples were obtained after screening. Among the respondents, 3,416 (98.9%) were students staying in Guangdong province, 44 majors included. Thousand two-hundred and sixty-five were students from secondary technical school, of which 423 (33.4%) were male students and 842 (66.6%) female students, and 2,189 were junior college students, of which 782 (35.7%) male students and 1,407 (64.3%) female students. Male and female students took up 36.5 and 63.5% of the total valid survey population, respectively. The respondents were 15–25 years of age (mean age: 20.03; *SD:* 1.734).

Tools

We used four questionnaires to measure four dimensions (perceived social support, coping tendency, generalized anxiety, and stress reaction) and collected the respondents' sociodemographic information, including gender, age, grade, place of residence, education level, etc.

Perception of Social Support Scale

The Perception of Social Support Scale (PSSS) assesses an individual's self-understanding and self-perception and reflects the individual's overall level of perceived social support. Formulated by Zimet et al. (1990) and introduced and revised by Qianjin Jiang (Zimet et al., 1990), the scale includes three dimensions, i.e., family support, friend support, and other support, and each dimension contains four items, for a total of 12 items, and is scored using an 7-point Likert scale; the higher the score is, the higher the perceived social support. The Cronbach's alpha value for the questionnaire used in this study is 0.942.

Simplified Coping Style Questionnaire

Coping style was measured using the Simplified Coping Style Questionnaire (SCSQ). This questionnaire was developed by Xie based on the Ways of Coping Questionnaire by Folkman and Lazarus (1988) (Xie, 1998). It is a 20-item self-report questionnaire that includes two dimensions, active coping (12 items) and passive coping (8 items), with higher scores representing greater active/passive coping. Participants are asked to agree or disagree, using a 4-point Likert scale (from 1 "never" to 4"very often"), according to how frequently they adopt each item. The instrument has been commonly used in China, and the Cronbach's alpha coefficient is 0.888.

Generalized Anxiety Disorder

The scale Generalized Anxiety Disorder (GAD-7) includes seven items to assess an individual's anxiety symptoms in the past 2 weeks and is scored using a 4-point Likert scale (0 = Never; 1 = Once in a few days; 2 = Once in more than half of the days; 3 = Once almost every day), with a total score ranging from 0 to 21 (Spitzer et al., 2006); the higher the score is, the more severe the anxiety: 0–4 points, normal; 5–9 points, mild anxiety; 10–14 points, moderate anxiety; and 15–21 points, severe anxiety. The Cronbach's alpha value for this questionnaire is 0.930.

Impact of Events Scale

The Impact of Events Scale (IES-6) is simplified from the Impact of Events scale (IES-R) by Thoresen and thus is highly correlated with the ISE-R (Thoresen et al., 2010). It is a powerful and simplified version of the ISE-R, contains six items in three dimensions [intrusion symptoms (4–5), avoidance symptoms (1, 3), and high alertness (2, 6)] and is scored using a 5-point Likert scale (0 = Never; 1 = Occasionally; 2 = Sometimes; 3 = Frequently; and 4 = Always). The average score (total score divided by 6) is used to assess the likelihood of PTSD: $<$ 1.09, normal; 1.09 $\leq$ and $<$ 1.5, likely PTSD; $\geq$1.5, PTSD. The Cronbach's alpha value for this questionnaire is 0.803.

Statistical Analysis

We used Mplus 8.3 to perform LPA of the overall data to examine the difference in the levels of perceived social support in the tested groups. Using SPSS 19.0, we calculated the mean and standard deviation for the scores for the 20 coping strategy items; the data were then Z-transformed to be standardized and worked out the coping tendency score. Based on the coping tendency score, we divided the participants into two groups, i.e., those who adopted positive coping strategies (positive coping group) and those who adopted negative coping strategies (negative coping group), to compare the differences in individuals with different levels of perceived social support. Furthermore, we examined the differences in demographic characteristics within each subgroup through multivariate logistics regression analysis using the secondary subdivision result as the dependent variable and other indicators (e.g., gender and age) as independent variables. Finally, we compared the mental health differences among individuals in each subgroup through single factor analysis of variance (ANOVA).

RESULTS

LPA of Students' Perception of Social Support

To examine perceived social support patterns among secondary technical school students and junior college students, we performed LPA of the PSSS scores. The fit indices for two to five classes were extracted and analyzed with model comparison. The model fit test indicators included the Akaike information criterion (AIC) and Bayesian information criterion (BIC), the sample size-adjusted BIC (aBIC), and entropy index (Xian et al., 2005), the likelihood ratio test indicator Lo-Mendell-Rubin adjusted likelihood ratio test (LMR-LRT) (Lo et al., 2001), and the bootstrap-based likelihood ratio test (BLRT) index (Peel and McLachlan, 2000). The lower the values are for the three information assessment indicators, the better the model fit. The valuation range for the entropy index is 0–1, and the closer the value is to 1, the more accurate the classification; entropy <0.60 indicates that more than 20% of individuals are misclassified, and entropy = 0.8 indicates that the accuracy of the classification exceeds 90%. If the *p*-values for the LMR-LRT and BLRT reach a statistically significant level, then the K-class model is significantly better than the k-1-class model (Muthén and Muthén, 2000).

The data showed that the conclusions based on the different information indicators were inconsistent and that the entropy values for the four models all exceeded 0.8. When five classes were retained, the AIC, BIC, and aBIC values were low, and the LMR-LRT(*p*) and BLRT(*p*) values were lower than 0.01, indicating that in terms of the indicators, all four latent class models satisfied statistical requirements. The estimated condition means for the four latent class models of the 12 items of perceived social support are shown in **Table 1**.

In terms of statistical indicators, with each added subclass, the AIC, BIC, and aBIC values decreased. However, when determining the best model, the interpretability of each class should also be considered (Finch and Bronk, 2011). **Figures 1A,B** show that when four and five classes, respectively, are retained, the conditional probabilities of the extremely low perceived social support group, low perceived social support group and high perceived social support group were very similar. However, in the five-class model, two classes were intertwined with each other at the medium perception level, with non-significantly different conditional probabilities and a weak explanatory power. Nevertheless, the four-class model classified each class very well, with an entropy value of 0.930, indicating that the four-class classification was accurate; therefore, this model was chosen as the optimal model for this study after comprehensive consideration.

TABLE 1 | Latent profile classification of the perceived social support of the overall population.

Index	Number of model			
Total (n = 3,454)	**2**	**3**	**4**	**5**
AIC	128,229.515	124,371.861	120,824.736	118,358.292
BIC	128,456.964	124,679.225	121,212.015	118,825.485
aBIC	128,339.398	124,520.351	121,011.835	118,583.997
Entropy	0.952	0.972	0.930	0.958
LMR-LRT(p)	<0.001	<0.001	<0.001	<0.001
BLRT(p)	<0.001	<0.001	<0.001	<0.001

Figure 1A shows that the conditional mean values for the four latent classes of the 12 items in the three perceived social support dimensions were significantly different, indicating different characteristics. Among them, for Class 1 (C1), the conditional mean values for the three dimensions of perceived social support were all the lowest, showing no significant fluctuations; C1 contained a total of 50 individuals, accounting for 1.4% of all participants, and based on their scores, C1 was defined as the "extremely low perceived social support group (ELPSSG)." The overall scoring trend for Class 2 (C2) was similar to that for C1 but with significantly higher conditional mean values; therefore, C2 was defined as the "low perceived social support group (LPSSG)," containing 1,534 individuals, accounting for 44.4% of the total participants. The conditional mean values for Class 3 (C3) were higher than those for C2; therefore, C3 was defined as the "medium perceived social support group (MPSSG)," containing 985 individuals, accounting for 28.8% of the total participants. The scores for individuals in Class 4 were the highest among all groups for each item; therefore, C4 was defined as the "high perceived social support group (HPSSG)," containing a total of 885 individuals, accounting for 25.4% of the total participants.

The scores for the ELPSSG and LPSSG did not differ significantly for all items, indicating that the classification of social support sources perceived by these two groups is unclear. The MPSSG recorded low scores for "when I have difficulties, someone (teacher, classmate, or relative) will show up," "when in trouble, I can rely on my friends," and "I can talk about my problems with my family" but

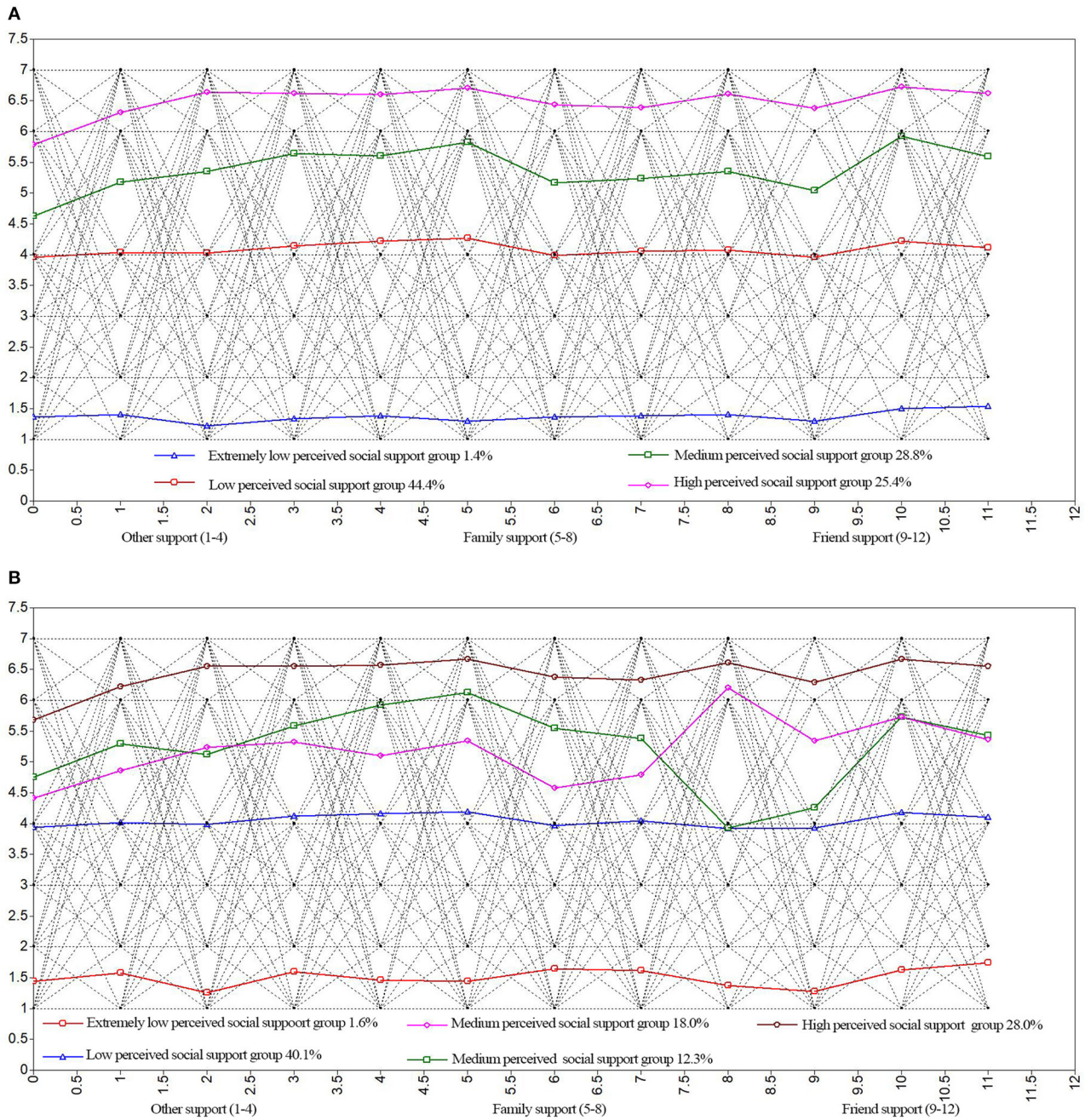

FIGURE 1 | (A) Four and **(B)** Five classes of perceived social support of the overall population. ELSSPG, Extremely low perceived social support group; LPSSG, Low perceived social support group; MPSSG, Medium perceived social support group; HPSSG, High perceived social support group.

high scores for "I get emotional help and support from my family when in need" and "my friends can share both happy and sad times with me," indicating that individuals in this class can clearly determine the type of social support source they perceive. The perception trend for the HPSSG group was similar to that for the MPSSG group but with smaller differences between the classes. In other words, emotional support from family and empathy with friends were the most obvious perceived sources of social support, while the support source of solving practical difficulties was less perceived by the students.

Analysis of Coping Tendencies for Different Perception Classes

Based on the four latent classes from the LPA, we examined the relationship between students' perceived social support and

their coping tendencies when facing the COVID-19 pandemic. First, through the SCSQ, we divided the overall population into two groups: positive coping group and negative coping group. Specifically, using SPSS 19.0, we calculated the mean and standard deviation for the scores for the 20 coping strategy items; the data were then Z-transformed. Based on the formula for coping tendency, i.e., coping tendency = (total score for the coping strategy items – mean)/standard deviation, to obtain the Z-standardized score for each coping strategy, the value for coping tendency was obtained by subtracting the standardized negative coping strategy score from the standardized positive coping strategy score. If the coping tendency value was negative, the participant mostly adopted negative coping strategies under stress; if the coping tendency value was 0 or positive, the participant was more inclined to adopt positive coping strategies under stress. Accordingly, the individuals were divided into two groups: positive coping group and negative coping group. Combining the LPA analysis results for the four latent classes and the two coping tendency groups, we generated eight subclasses and further examined their differences and trends. The subdivision results are provided in **Table 2**.

TABLE 2 | Subdivided classes of perceived degree of social support-coping tendency.

Latent profile	Coping style		Total (*n*)
	Negative *n* (%)	Positive *n* (%)	
ELPSSG	43 (86%)	7 (14%)	50
LPSSG	1,151 (75%)	383 (25%)	1,534
MPSSG	541 (54.9%)	444 (45.1%)	985
HPSSG	383 (43.3%)	502 (56.7%)	885
Total (*n*)	2,122	1,332	3,454

ELSSPG, Extremely low perceived social support group; LPSSG, Low perceived social support group; MPSSG, Medium perceived social support group; HPSSG, High perceived social support group.

We named the eight subclasses according to the perceived level of social support-coping style as follows: ELPSSG-negative coping style (ELPSSG-N): 43 individuals, accounting for 86% of the total participants; ELPSSG-positive coping style (ELPSSG-P): 7 individuals, accounting for 14% of the total participants; LPSSG-N: 1,151 individuals, accounting for 75% of the total participants; LPSSG-P: 383 individuals, accounting for 25% of the total participants; MPSSG-N: 541 individuals, accounting for 54.9% of the total participants; MPSSG-P: 444 individuals, accounting for 45.1% of the total participants; HPSSG-N: 383 individuals, accounting for 43.3% of the total participants; and HPSSG-P: 502 individuals, accounting for 56.7% of the total participants. The trends for the subclasses are provided in **Figure 2**.

The results shown in **Table 2** and **Figure 2** indicate that with an increased level of perceived social support, the proportion of individuals who adopted negative coping strategies in the negative coping tendency group declined; in contrast, the proportion of individuals who adopted positive coping strategies in the positive coping tendency group increased. The level of perceived social support is positively correlated with coping tendency.

Analysis of Gender and Grade for Different Perception Classes

Based on the LPA results, we further examined the demographic characteristics of each social support perception class. We conducted a multivariate logistic regression analysis using the LPA results as the dependent variable and gender (females as the reference) and grade (junior college as the reference) as independent variables, with Class HPSSG-P as the reference class for comparison. The odds ratio (OR) was obtained to reflect the ratio of the ratios of gender to grade at each level of perceived social support. The multivariate logistic regression analysis results are provided in **Table 3**.

HPSSG-P, as the reference group, was compared with the other seven subclasses, and the ORs showed that the population distribution for the coping tendency-social support model was not significantly affected by grade. Two classes (ELPSSG-N and LPSSG-N) were significantly affected by gender, but for all the

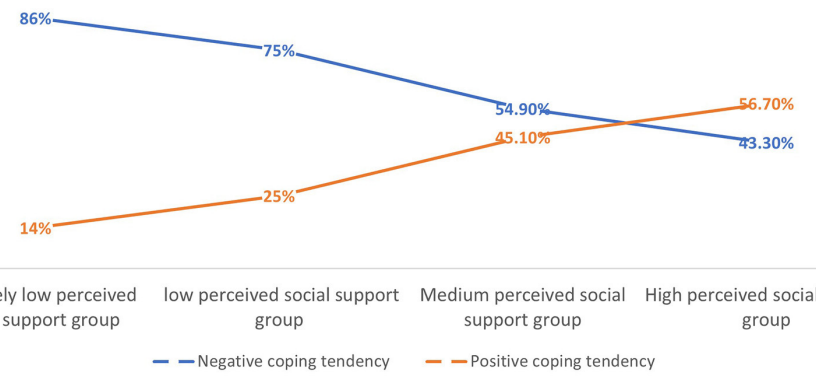

FIGURE 2 | Trends for subclasses of different perceived levels of social support-coping styles.

other classes, gender showed no impact. Therefore, most of the time, gender was not an important factor as it only worked in extremely negative situations, such as low perceived social support and negative with negative coping tendency.

Comparisons for Students' Coping Tendency-Perceived Social Support

The ANOVA results for the anxiety scores for different coping tendency-perceived social support latent classes, $F = 30.768$ ($P < 0.01$), and for the standardized COVID-19 influence scores, $F = 6.177$ ($P < 0.01$), are provided in **Table 4**. Multiple comparisons showed that in terms of generalized anxiety, the scores for all the positive coping subgroups were lower than those for all the negative coping subgroups, indicating that the level of anxiety in individuals in the positive coping group was lower than that in individuals in the negative coping group. More importantly, as the level of perceived social support increased, the level of anxiety in individuals with negative coping tendencies decreased, but in individuals with positive coping tendencies, the level of anxiety increased first and then declined. In terms of the impact of the COVID-19 pandemic, the scores for all the positive coping subgroups were lower than those for all the negative coping subgroups, but those for the individuals in the ELPSSG were higher. Notably, the score for the negative tendency group fluctuated significantly, while that for the positive tendency group was low but increased. Overall, students' mental health was better in the higher perceived social support– positive tendency groups, than the lower ones.

TABLE 3 | Latent profile and coping tendencies for different levels of perceived social support.

		Gender		School type	
Subgroup	**OR/CI**	**Female**	**Male**	**College**	**Secondary school**
ELPSSG-N	OR	1.00	5.049**	1.00	0.623
	CI (95%)		2.592–9.834		0.306–1.268
LPSSG-N	OR	1.00	1.789**	1.00	1.609
	CI (95%)		1.428–2.243		0.860–1.330
MPSSG-N	OR	1.00	1.072	1.00	1.040
	CI (95%)		0.821–1.399		0.809–1.338
HPSSG-N	OR	1.00	1.220	1.00	0.953
	CI (95%)		0.915–1.626		0.772–1.258
ELPSSG-P	OR	1.00	3.306	1.00	1.345
	CI (95%)		0.730–14.964		0.297–6.084
LPSSG-P	OR	1.00	0.988	1.00	1.145
	CI (95%)		0.784–1.245		0.919–1.427
MPSSG-P	OR	1.00	1.264	1.00	0.965
	CI (95%)		0.949–1.683		0.731–1.273
HPSSG-P	OR	1.00	0.933	1.00	0.990
	CI (95%)		0.702–1.239		0.759–1.291

ELSSPG, Extremely low perceived social support group; LPSSG, Low perceived social support group; MPSSG, Medium perceived social support group; HPSSG, High perceived social support group; N, Negative coping tendency; P, Positive coping tendency.
***means p < 0.01.*

DISCUSSION

COVID-19 has had a globally devastating impact, threatening not only the learning of tens of millions of students but also their mental health. The impact of such public health emergencies is destructive, unpredictable and overwhelming and that their impact on an individual's mental health may manifest as acute mental stress as well as chronic mental stress and corresponding mental reactions. The same is true for secondary technical school students and college students (Grubic et al., 2020). Due to the spread of the epidemic, a host of factors, such as stress regarding health, increased time living with parents, changes in learning style and environment, etc., have caused students to be unable to perform their duties. For students, the effect of deferred school openings, decreased employment opportunities, and school transfers has caused tremendous pressure. According to the results of data analysis, the coping ability of college students was shown to be at an intermediate level, a result that might be related to the fact that college students had trouble adapting to the epidemic, academic arrangements, and other factors. Therefore, understanding the perceived social support patterns and coping tendencies of the student population will help build a more targeted social support system to help them cope with the COVID-19 pandemic and similar crises.

In this study, we found that 50 students in the ELPSSG (accounting for 1.4% of the total participants) only perceived extremely low social support, while 1,534 students in the LPSSG (accounting for 44.4% of the total participants) perceived a medium level of social support (4 points); students in both groups were unable to clearly perceive the source of social support they received. In addition, 985 students in the MPSSG (accounting for

TABLE 4 | Impact of the COVID-19 pandemic and anxiety levels in different latent profile.

	Negative groups ($M \pm SD$)				**Positive groups ($M \pm SD$)**				
	ELPSSG-N ($N = 43$)	**LPSSG-N ($N = 1,151$)**	**MPSSG-N ($N = 541$)**	**HPSSG-N ($N = 383$)**	**ELPSSG-P ($N = 7$)**	**LPSSG-P ($N = 383$)**	**MPSSG-P ($N = 444$)**	**HPSSG-P ($N = 502$)**	***F***
GAD	3.35 ± 5.136	3.02 ± 3.808	2.55 ± 3.106	2.13 ± 2.850	0.29 ± 0.488	1.36 ± 2.633	1.45 ± 2.321	1.09 ± 1.992	30.768
IES	0.957 ± 0.781	1.246 ± 0.698	1.199 ± 0.602	1.230 ± 0.648	1.095 ± 0.838	1.088 ± 0.633	1.083 ± 0.681	1.113 ± 0.613	6.177

GAD, Generalized anxiety disorder, IES, Impact of Events Scale, ELSSPG, Extremely low perceived social support group; LPSSG, Low perceived social support group; MPSSG, Medium perceived social support group; HPSSG, High perceived social support group; N, Negative coping tendency; P, Positive coping tendency.

28.8% of the total participants) perceived moderate emotional support and lower levels of substantial support from family and friends, e.g., when in trouble, the companionship of teachers, classmates, or relatives; the dependability of friends; and communication with family were at a medium level of perception. Last, 885 students in the HPSSG (accounting for 25.4% of the total participants) perceived a high degree of overall support. Relative to those in the MPSSG, students in the HPSSG perceived lower companionship of teachers, friends, or relatives, with higher dependability of friends and few communication problems with their family. Overall, emotional support from family and friends enabled the students to perceive a high level of social support; however, the dependability of friends and communication problems with family reduced students' perceived social support, this result is consistent with the suggestion of Ratelle et al. (2013), the higher of perceived social support, the higher of positive attitude. To conclude, individuals were able to clearly judge the type and degree of social support sources as the key factor which allows the determination of favorable and unfavorable factors in students' social support system.

We also examined the effect of different levels of perceived social support on students' coping tendencies and found that the level of perceived social support is positively correlated with students' coping tendencies. The higher the perceived social support level, the higher is positive coping tendencies and the lower is negative coping tendencies. If students cannot clearly identify types of social support sources, they are more inclined to adopt negative coping strategies. For example, in the ELPSSG and LPSSG, the students had similar scores for each item but no distinct source of social support, and 86 and 75% of the students, respectively, were inclined to adopt negative coping strategies. Individuals who can clearly perceive the emotional support of family and friends have a reduced probability of adopting negative coping tendencies, e.g., the probability of individuals in the MPSSG and HPSSG adopting negative coping strategies decreased to 54.9%. With the increased dependability of friends and decreased communication problems with family, the probability of students adopting negative coping strategies decreased further to 43.3%, as in the case of the HPSSG. These results again verified the hypothesis of the social support theory proposed, i.e., support from social relations can prompt individuals to adopt positive coping strategies (Andrews et al., 1978), the family's role of emotional support and friends' emotional support (Labrague et al., 2020; Liu et al., 2020). The results indicate that in stressful situations, those who have a high level of physical or mental support from a spouse, friend or family member have better mental and physical health than those who have a low level of physical or mental support.

In contrast to the finding of Elmer et al. (2020), female students appeared to have worse mental health trajectories when controlling for different levels of social integration and COVID-19 related stressors, our research showed partial different results, by examining the demographic characteristics of participants in the eight subclasses, we found that two subclasses, ELPSSG-N and LPSSG-N, with a total of 1,194 individuals (34.6%), were significantly impacted by gender, while the other six subclasses were not, a result that is consistent with those from other studies. Furthermore, secondary technical school students and junior college students were assessed separately regarding the effect of grade on students' perceived social support-coping strategy. Grade had a non-significant impact on students in all subclasses, indicating that, for 15–25 year-old students in secondary technical school or junior college, their perceived social support-coping patterns are the same and that the results of this study have a wider application range.

Social support can benefit individuals' mental health, and those with a high level of social support have more emotional stability and better physical and mental health than those with a low level of social support (Mak et al., 2011; Cao et al., 2020). We examined the mental health status of participants in eight latent classes of perceived social support-coping strategies using the IES-6 and GAD-7. We found that in terms of the impact of the COVID-19 pandemic, the scores for all groups with positive coping tendencies were lower than those of groups with negative coping tendencies; however, those for individuals in the ELPSSG (1.5%) were higher. These findings verified, to a certain extent, that the degree of perceived social support-coping tendency is positively correlated with students' emotional stress response. Except for the outlier subclass ELPSSG, the other six subclasses showed the high score initially and then a low score. These findings verified the hypothesis that social support has a universal beneficial effect on individuals, it can help the individual cope with the stress and improve their mental health. The general effectiveness of social support may be derived from stable social network providing positive experiences. For example, an individual who obtains help and support from others has reduced anxiety and fear when facing a stressful event; when facing a stressful event again, the individual can better cope with stress and improve his/her mental health thanks to previous experiences and existing social support. Moreover, a stable social network also improves an individual's sense of self-worth while avoiding negative experiences (Grubic et al., 2020; Li et al., 2020; Yildirim and Tanriverdi, 2020). Thus, our findings support the viewpoints of Cao et al. (2020) and Mak et al. (2011), social support has a buffering effect on individuals facing stress and can mitigate the negative impact of stress events on physical and mental health and thus maintains and improves physical and mental health.

The level of anxiety in individuals who adopted positive coping strategies was lower than that of those who adopted negative coping strategies. The level of anxiety in individuals with negative coping tendencies decreased as perceived social support levels increased, while that in those who adopted positive coping strategies increased first and then decreased. These trends were likely due to the in ability of the students to clearly perceive social support sources and, thus, impossible for them to know whether the positive actions they take are supported. Moreover, anxiety may also be related to the contradiction between the high level of perceived emotional support from family and friends and low friend dependability and decreased family communication. The anxiety level of participants in the MPSSG-P subclass was significantly lower than that of participants in the HPSSG-P subclass; the conflict among these factors was more substantial

in the MPSSG-P than in the HPSSG-P. The results of this study partially verify that social support has a positive effect on health, can buffer the impact of stress and provides emotional support and instrumental support so that individuals can better adapt to stress to improve health (Martín-Albo et al., 2015; Stenling et al., 2015), as well as support the findings of Yan and Zheng (2003), social support has a significant regression effect on individuals' subjective well-being as well as a positive correlation with the total score for subjective well-being, life satisfaction, and positive emotions and a negative correlation with negative emotions (Yan and Zheng, 2003; Chang et al., 2020). Therefore, support from social relations can enhance individuals' ability to regulate emotions by prompting them to adopt positive coping strategies, thereby obtaining a higher level of subjective well-being.

The results of our findings offer some practical implications. Firstly, according to our findings, emotional supports from family is important to students' resilience. We suggest that this kind of social support should be promoted by improving the parent-child communication. For example, the relevant parties should be frank with each other and talk with each other about their stress, anxiety, and uneasiness to gain and enhance mutual understanding and support. Family members should keep in touch with each other and help, support and encourage each other so as to strengthen family cohesion and form family dependence. Secondly, the findings showed that the support from teachers was insufficient due to the possible reason that students stayed at home in the period. The possible idea may be by leveraging social medias, teachers may deliver their support to students more effectively (Wu and Song, 2019). For example, through online teaching, training, classes, themed activities, and psychological consultations, with the school as the center and activities as support, teachers should guide and help students to adapt to new learning methods and establish channels for communication so that students can receive academic assistance and enhance their spiritual identity. Finally, students might interact with peers such as communication, exchange, and discussion with classmates by participating in learning activities and sharing interests and issues with friends may obtain understanding, support, trust, and companionship.

Limitations and Future Research Directions

As with any empirical study, this work cannot avoid its limitations. First, although we tried our best to expand the sample size, the bias of sample selection such as all the students coming from the same province may limit the generalization of the findings. Besides, the findings are based on self-reported data and may constraint the reliability of the result. Future research might consider in-depth interviews to provide triangulated information as complementary illustrations of the findings. Furthermore, this paper offers insights on emotional supports from family and friends that affected student's resilience during the COVID-19 pandemic. Future investigations should experiment on explaining why and how these two types of social support sources can stimulate students' positive coping tendency and thus improve their mental health.

Second, our work focused on the role of students' perception of social support on resilience in the context-specific of the Covid-19 pandemic. Future work might verify if the findings can be applied to other contexts or not. For example, future work might compare the role of students' perception of social support on resilience between ordinary difficulty and extreme crisis. In addition, this work focused on students' perception of family support, friend support, and other support. Future research might explore whether there are other factors that affect the positive tendency response of students.

CONCLUSION

In summary, this paper aims to explore the impact of the perception of social support and students' resilience of students from secondary technical school and college (15–25 years old) on their ability to cope with the impact of the COVID-19 pandemic and stress. Our results show that (1) students' inability to clearly perceive social support sources reduces their tendency of adopting positive coping strategies while students are more likely to take positive coping strategies when they perceived higher level of social support; (2) individuals with a high level of perceived emotional support from family and friends can increase their tendency of adopting positive coping strategies, while a low level of perceived help from teachers, classmates and relatives, a lack of dependable friends, and communication problems with family will reduce students' tendency of adopting positive coping strategies; (3) The higher the degree of perceived social support the more likely students adopt positive coping strategies, and thus improve their mental health. The findings are conducive to designing more targeted support programmes for secondary technical school students and college students to alleviate their stress caused by the COVID-19 pandemic.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

YM carried out the concepts, design, data analysis, and manuscript editing. YW carried out the concepts, design, and manuscript editing. YH carried out the data acquisition and manuscript editing. All authors contributed to the article and approved the submitted version.

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Effective Learning Support Towards Sustainable Student Learning and Well-Being Influenced by Global Pandemic of COVID-19: A Comparison Between Mainland China and Taiwanese Students

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The novel coronavirus disease that emerged at the end of 2019 began threatening the health and lives of millions of people after a few weeks. However, social and educational problems derived from COVID-19 have changed the development of individuals and the whole country. This study examined the learning method of Taiwanese versus mainland China college students, and evaluated the relationship between learning support mechanism and subjective well-being from a social cognition theory perspective. In this study, a total of 646 Taiwanese questionnaires and 537 mainland China questionnaires were collected to compare the two sample groups in development of students' subjective well-being. The results showed that social capital and learning support had significant positive correlations with self-efficacy, student employability and well-being and self-efficacy and student employability had significant positive correlations with well-being in Taiwanese sample. In mainland China sample, except paths among social capital, learning support, student employability and well-being, all paths were significant and positive related. Finally, based on the conclusions this study proposed some suggestions specific to theoretical mode for future study.

Keywords: social capital, learning support, self-efficacy, student employability, subjective well-being

INTRODUCTION

The influence of learning environment and learning mode of students on learning motivation and learning outcome has always been a key focus in the field of educational psychology (Fantuzzo et al., 2014; Bailey and Phillips, 2016; Jelas et al., 2016). Many studies have found that a good learning environment will help students strengthen their learning motivation and acquire knowledge and skills they need, thus improving the psychological state of achieving goals they set (Bailey and Phillips, 2016; Hanson et al., 2016; Denovan and Macaskill, 2017). Most of these studies were conducted in a complete learning environment. In particular, a majority of these studies have verified the importance of online learning or technology learning (Cheng et al., 2011). However,

since the global pandemic of COVID-19 from January 2020, countries all over the world have begun to stop exchanges, such as economics, tourism, and productions, especially educational activities. In order to contain the spread of COVID-19, countries have to cease many economic and educational activities, and postpone the school opening date. In order to enable students to continue learning in the process of combating the epidemic, teachers start to teach students online, which allows students to acquire knowledge with the help of technological carriers. Nevertheless, the impact of teachers' lesson preparation and students' acceptance of online learning within a limited period of time on learning outcome remains to be observed (Kramarski et al., 2010), especially because everyone in such a learning context feel anxious and stressed (Bewick et al., 2010; Fantuzzo et al., 2014; Denovan and Macaskill, 2017). Therefore, this study intends to explore the current development status of student learning activities in the context of global pandemic of COVID-19.

A majority of studies on higher education have discussed factors influencing learning outcomes of students (Pike et al., 2012; Bailey and Phillips, 2016), or the application effect of learning models (Pascarella et al., 2013; Campbell and Cabrera, 2014). Some studies in recent years began to discuss the shape of student subjective well-being (SWB) from the view of educational psychology. The emergence of positive psychology leads the psychology (Seligman and Csikszentmihalyi, 2000) into a new direction. Under the influence of the positive psychology, counseling and psychotherapy begin to turn their attention to positive affect subject (Stallman et al., 2018). Many scholars advocate to emphasize the well-being of adolescent, and believe that SWB is the core of adolescent's mentally healthy development (Miller et al., 2008; Graham et al., 2016). This study replaces student learning outcome with student SWB as the core view: (1) SWB, as the major concerns of student personality and social psychology, is used to examine social change and improvement of educational policies and solve student learning problems (Bailey and Phillips, 2016; Hanson et al., 2016; Stallman et al., 2018); (2) the discussion of student SWB will put emphasis on finding symptoms such as possible depression, anxiety, and psychological disorder (Bailey and Phillips, 2016); the positive and negative psychology lies between two extremes of continuous psychological states, and the more well-being of students will help students face challenges with a positive psychological state, and increase the value of learning course (Stallman et al., 2018). Considering the above reasons, this study aims to further understand and discuss the development course of student SWB through enhancing student employability (SE) in the learning process. (3) From the angle of cross-culture, it can be seen that there are same measurements for learning outcome in different cultures, But in terms of SWB, western culture upholds individual feeling and independence, while oriental culture puts emphasis on social norms and the value of sharing and co-fusion. Western and oriental cultures also have varied ways of understanding, experiencing and pursuing well-being. Based on the above reasons, this study aims to explore the development of students' SWB in the changing learning activities.

The social cognitive theory contributes to building an appropriate research framework to discuss the relevance between learning activities, environmental influencing factors and psychological needs (Cupani et al., 2010; Bocanegra et al., 2016; Burga et al., 2020). According to the social cognitive theory (SCT), Bandura (1986) hold that personal attribution, environmental influencing factors and intentional behaviors will form a triangular relationship of interaction (Lent et al., 2017; Lent et al., 2018). In other words, individual behaviors are formed by the interaction of individual's inner thoughts, emotions and environment (Jelas et al., 2016). It is found from the SCT architectural pattern that there is an indirect effect of personal cognitive factors between environmental factors and behavioral factors. In other words, when personal cognitive factors are expected to directly affect student SWB (Lent et al., 2017, 2018), the effect of external environmental factors on student SWB becomes negligible (Fantuzzo et al., 2014; Hanson et al., 2016; Jelas et al., 2016). Self-efficacy is not only the belief of students in their own successful performance and specific behaviors and abilities related to education (Van Dinther et al., 2011), but also an important factor inspiring spontaneous learning motivation and engagement (Parker et al., 2006; Lent et al., 2017, 2018), as well as the core of SCT. Thus, this study proposes that the combination of cognitive factors and the social cognitive theory between self-efficacy and student SWB is supposed to enrich the existing literature.

Moreover, in the aspect of individual cognitive factors, the Pygmalion effect in educational psychology stresses that the external links of students will influence learning intentions and learning outcomes of students. When students perceive expectation and affirmation of important others, they will perform better (Kramarski and Michalsky, 2010; Holfve-Sabel, 2014; Bailey and Phillips, 2016; Graham et al., 2016; Stallman et al., 2018). Scholars have found that the interaction of students with important others such as families, teachers and peers will have an effect on their learning interests and learning outcomes (Bojuwoye et al., 2014; Bailey and Phillips, 2016; Hanson et al., 2016). Further observations show that students have more perseverance and confidence in face of learning challenges if they obtain more kindness, care and support from important others (Kramarski et al., 2010; Jelas et al., 2016; Wibrowski et al., 2017). This study proposes that social capital and learning support are important external environmental cognitive factors in the process of student learning, and employability is the learning output (i.e., skills and knowledge). Regarding the psychological and sociological characteristics, this study is based on students' social capital (Pike et al., 2012; Peng, 2019) and learning support (Cheng et al., 2011; Bojuwoye et al., 2014; Bailey and Phillips, 2016). The connections of teacher, family, and peer influence students' employability, changing their cognition of study and assignments. The concept of social capital and learning support pertains to the resources (Cheng et al., 2011; Bojuwoye et al., 2014; Holfve-Sabel, 2014). Social capital and learning support are the most important resources for students to gain more self-efficacy and enhance their employability (Kramarski et al., 2010; Van Dinther et al., 2011; Jelas et al., 2016).

According to the report of Bloomberg in March 2020, only students in Taiwan and Sweden attend the school as usual due to the global pandemic of COVID-19. In order to explore the differences of regions in learning activities caused by environmental threat factors and the changes of student SWB (Lent et al., 2017, 2018), students in Mainland China and Taiwan were taken as the research samples of the interregional comparison in order to learn about the relevance of the research variables. Therefore, this study focuses on determining university students' perceptions of the psychological and sociological drivers of employability, self-efficacy and well-being in higher education, as well as the relationships among them. The following questions are investigated:

(1) Are there significant associations among students' perceptions of social capital, learning support, self-efficacy, employability and well-being?
(2) Do students' employability and self-efficacy play mediating roles in the relationship between the antecedents (psychological and sociological drivers) and consequences of well-being?
(3) Due to Global Pandemic of COVID-19, do various learning activities influence the effect of students' learning antecedents on self-reported gains in well-being?

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Theoretical Background of Social Cognition Theory

Social Cognitive Theory (SCT) as an initial foundation in this study for effective learning support toward sustainable student learning and well-being Influenced (Bocanegra et al., 2016; Lent et al., 2017, 2018). SCT is an empirically validated model that have been widely accepted (Cupani et al., 2010; Burga et al., 2020). It is a method for understanding and predicting changes in human behaviors and cognitive behaviors. According to this theory, human meta-development occurs through continuous interaction with the external environment, and the environment must go through a cognitive process before affecting human behaviors (Bocanegra et al., 2016; Lent et al., 2017, 2018). The theory proposes that there is a ternary interactive and causal relationship between cognitive factors, environmental factors and human behaviors. Behavior is influenced by both cognitive and environmental factors (Bandura and Wood, 1989; Van Dinther et al., 2011). Specifically, cognitive factors refer to individual's cognition, emotion and actual events, and environmental factors refer to the social and physical environments that can affect human behaviors (Cupani et al., 2010; Burga et al., 2020).

According to Bandura, self-efficacy is the key structure of SCT and is believed to have a direct impact on behavior (Cupani et al., 2010; Bocanegra et al., 2016). The outcome expectation is the second structure of SCT, representing a person's judgment on the consequences resulting from the execution or non-execution of a specific behavior (Bandura, 2004). The pattern of manifestation of outcome expectation can be embodied as self perception (Bandura, 1997), such as SWB. The goal is the third core structure of SCT, and can have a direct impact on behavior and regulate other structures in the model (Bandura, 2004). Achievement of goals requires specific self-regulation skills, such as gaining employability and completing specific goals.

Although Bandura clearly described a social cognitive structural network (Bandura and Wood, 1989), self-efficacy in the past studies has received more attention than other model groups (Van Dinther et al., 2011), or only one or two other variables are used to examine the self-efficacy (Rhodes and Nigg, 2011). This study believes that self-efficacy cannot be studied in isolation. We will use the SCT framework to further understand the impact of changes in the learning environment of students in mainland China and Taiwan during the global epidemic of COVID-19 on SWB. More specifically, the purpose of this study is to examine the impact of social capital (Pike et al., 2012; Peng, 2019) and learning support on self-efficacy and employability, analyze the relationship with student SWBs, and determine whether the effect arising from such relationship varies with regions.

Subjective Well-Being

People will eventually begin to reflect on the self-seeking of material satisfaction, further seeking psychological satisfaction and beginning to emphasize the importance of quality of life (Lent et al., 2017, 2018); thus the proposal of the concept of SWB (Hanson et al., 2016; Denovan and Macaskill, 2017; Stallman et al., 2018). SWB is a result of satisfaction of life coupled with perceived positive and negative emotional intensity (Evans et al., 2017). Keyes and Waterman (2003) and Keyes (2005) expanded the definition to incorporate the concept of "social well-being" by merging the two (psychological well-being and emotional well-being) to delineate SWB as a sum of three aspects: in the sense of psychological well-being, it serves to explore self-psychological adjustment and the macro-consciousness of the individual's inner self; a sense of evaluating the function of the self in life through public and social norms; and lastly, emotional well-being as the individual's awareness and assessment of the emotional state of self-life (Evans et al., 2017).

For a long time, students in higher education have been facing many psychological and physical pressures that make students fail to handle learning challenges with a positive attitude (Bailey and Phillips, 2016; Stallman et al., 2018). Bewick et al. (2010) point out, in a study taking British students as the research object, that college students often have considerable pressure on loan, life and scholarship applications compared with their non-student peers (Bailey and Phillips, 2016; Denovan and Macaskill, 2017), and emphasize that scholars should shift their focus from learning outcome to the discussion of psychological problems of students (Hanson et al., 2016). Although scholars have discussed student SWB from different levels, there are still some research gaps that are worth discussing and exploring (Bailey and Phillips, 2016; Lent et al., 2017, 2018; Stallman et al., 2018), such as how SWB develops, and internal and external factors that affect students' mental health and SWB (Fantuzzo et al., 2014; Graham et al., 2016; Stallman et al., 2018). In addition, Folkman and Moskowitz (2000) point out in their research that the future research should focus on the discussion of positive emotions and SWB, because

it is impossible to find relevant factors that can effectively reduce mental health problems derived from stress if it is not discussed from the perspective of positive outcomes (Hanson et al., 2016; Denovan and Macaskill, 2017). Therefore, based on the social cognitive theory, this study uses SWB as the outcome variable to explore the influence of relevant factors on it. Understanding different mechanisms that contribute to students' overall well-being is of interest to parents, faculty, staff, and administrators (Hanson et al., 2016; Stallman et al., 2018).

Developing Subjective Well-Being in Higher Education

Two causal mechanisms contribute to SWB development in higher education: social capital (Pike et al., 2012; Peng, 2019) and learning support (Cheng et al., 2011). Given well-being building support, institutions or faculties can devise the learning context, such as psychological and essential factors, to enhance efficiency and responsiveness of knowledge learning (Wibrowski et al., 2017). Scholars claim that institutions or faculties utilize, integrate, and reconfigure internal and external factor to building an optimal learning context for constructing students' SWB (Van Dinther et al., 2011). Institutions or faculties implement series of support activities to pinpoint internal and external factor, where social capital focuses on sensing external market information (Pike et al., 2012; Peng, 2019) and learning support on acquiring, assimilating, transforming, and applying learning knowledge (Cheng et al., 2011; Wibrowski et al., 2017). This study considers a better way to build SWB as facilitating adaptation of support activities for social capital and learning support.

Well-Being Building Support Mechanism: Social Capital

Social capital is defined as "the aggregate of the actual potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" (Bourdieu and Richardson, 1986). According to Nahapiet and Ghoshal (1998), social capital is the existing or latent embedded resources acquired or transferred by individuals or social entities from social relationships. Social capital in universities is assumed by Peng (2019) to include community engagement, peer relationships, and relations between students and teachers. Social capital can be considered as a significant inherent supporting factor in the learning process. Stallman et al. (2018) indicate that the mental development of students may be negatively affected by isolation, while their learning and competences will benefit from good social support. In the process of interactions in social networks, students maintain their interest, learning motivation, attitude and efforts, which make them realize that they are accountable for their own future. Social capital enables students with higher socio-economic status to develop better relationships with teachers and peers, thus forming rich social capital that will create advantages or them in the social stratum (Pike et al., 2012; Peng, 2019). Pike et al. (2012) mention that students who get along well with their teachers and adapt well to the environment would achieve better academic performance.

Students are facing changes in both learning and living environments, so the social capital is divided into the social capital in terms of learning and the social capital in terms of life. Through the adjustment of social capitals with different structure (Pike et al., 2012; Peng, 2019), students can obtain inner support and encourage required, or acquire resources and information required for changing learning modes, thus enhancing the confidence in completing learning tasks (Stallman et al., 2018). Moreover, the high degree of social capital represents the common language, values, or goals between students and others (Van Dinther et al., 2011). For instance, when the peers have a closer relationship, they would exchange more accurate information. In this case, students are more willing to devote necessary efforts to learning tasks, and successfully finish challenging schoolwork. Therefore, this study proposes H1:

H1: Social capital has a positive and significant impact on students' self-efficacy.

Students' social capital also includes the relation across communities, and the links formed based on common interests. For example, peer or communities in schools are a horizontal linking mechanism, which is conducive to links to external resources and information exchange, and facilitates the connection and interaction between heterogeneous populations or communities. Read et al. (2009) indicate that the richness and diversity of social capital in terms of knowledge and information transfer contents will enable students to overcome inefficiencies in learning skills, absorb skills and knowledge required for employment, and facilitate students to enrich themselves (Bauernschuster et al., 2010). Social capital has two direct interests: information and influence. It does not only accelerate the obtainment of information (Shane and Venkataraman, 2000; Van Dinther et al., 2011), but also improves information relevance and information quality (Adler and Kwon, 2002; Burt, 2009). For instance, individuals have close connections with colleges and universities, so they may get in touch with researchers through alumni to get emerging technology information that is to be commercialized. Therefore, this study proposes H2:

H2: Social capital has a positive and significant impact on student employability.

Adler and Kwon (2002) think that individuals can possess or increase beneficial social capitals through specific relational structure and interpersonal interaction, thus achieving individual goals and enhancing the personal sense of achievement. Szreter and Woolcock (2004) mentioned the importance of social network and support for SWB. In other words, in the learning process, students maintaining a good relationship with friends, peers, and teachers, or who is able to obtain proper helps from them, have higher social capital. This is conducive to improving personal feelings of SWB. In the learning process, the degree of mutual assistance among schoolmates will affect learning satisfaction and learning efficiency. Thus, more social capitals have a positive effect on the improvement of positive emotions (Helliwell and Huang, 2010; Helliwell et al., 2014).

Likewise, students can mitigate the influence caused by bad environmental events using these accumulated social resources in face of negative environmental events or in need of assistance. When students feel greatly stressed, and importance resources are losing, students' estimation on stress scenario will be affected if they have enough social resources, thus reducing adaptive strategies for negative emotions and improper use (Nohe and Sonntag, 2014). Therefore, this study proposes H3:

H3: Social capital has a positive and significant impact on students' SWB.

Well-Being Building Support Mechanism: Learning Support

Key classroom learning experience plays an important role in the learning process, and diversified social and academic integration activities happen in class, which make classroom learning experience a concern in the structure of higher education (Demaris and Kritsonis, 2008; Cheng et al., 2011; Jelas et al., 2016). In order to allow students to feel the enriched classroom learning experience and get learning skills, the explicit and essential learning support provided by relevant elements in class (Cheng et al., 2011; Jelas et al., 2016) will facilitate students to form norms for joint compliance from informal activities, strengthen cooperative behaviors among students and improve their problem-solving capability. According to Mashau et al. (2008) learning support includes supplementary, curriculum advice, academic mentoring, remedial or extra class instructions, assisting students to work in groups, developing study and note-taking skills, academic mentoring, school psychological services, medical and social work services, feeding scheme, and all other services for meeting special needs of learners and for preventing learning difficulties (Kramarski et al., 2010; Cheng et al., 2011). Chang et al. (2013) indicate that social relationship with peers and teachers is able to form a positive learning atmosphere, including the supportiveness from teacher traits and peer traits, thus facilitating students to obtain good learning experience. Bojuwoye et al. (2014) state that effective learning supports can maximize gains from available teaching and learning activities, enabling students to overcome learning disabilities, and enhance their esteem, acceptable social behaviors and academic success (Mashau et al., 2008; Wibrowski et al., 2017). By reference to the study of Chang et al. (2013), this study identifies with the opinion that learning support includes teacher supportiveness and peer supportiveness, which are used to measure this dimension.

Teacher supportiveness is the most direct and effective knowledge source for students. Teachers would assist students in school demands, accept the application of different courses, and solve confusions and anxiety arising from the application of technological learning in learning (Cheng et al., 2011; Bojuwoye et al., 2014). Besides, the support for effective learning through teaching innovation will improve the status of learning engagement (Jelas et al., 2016), intensify learning motivation and perfect the learners' successful learning scenarios (Kramarski et al., 2010). Learning support is also related to theories of learning motivation (Wibrowski et al., 2017). Combined with psychological features of students, conducive learning environments can be created to enable students to be more confident in completing schoolwork (Mulholland and O'Connor, 2016). Students will be more driven and motivated to engage in learning and understand values and insights brought by learning, thus improving student self-efficacy, if they feel the positive psychological environment established by learning support from teachers and peers. Therefore, this study proposes H4:

H4: Learning support has a positive and significant impact on students' self-efficacy.

Moreover, the learning support, with its relationship with SE, is helpful in improving students' interest in learning and the application of their professional skills, and in further enhancing students' capability (Cheng et al., 2011; Jelas et al., 2016). When facing practical problems, such as critical analysis, problem solving (Kramarski et al., 2010), and reflection, students can demonstrate better learning attitudes and critical thinking ability. Mulholland and O'Connor (2016) have confirmed that students who have accepted the learning support pattern will change their learning motives, attitudes, and behaviors so as to enhance their critical thinking, learning autonomy, and employment-related competencies (Wibrowski et al., 2017). Therefore, this study proposes H5:

H5: Learning support has a positive and significant impact on SE.

By strengthening psychological characteristics of student, learning support promotes better schoolwork engagement and effective learning (Gasiewski et al., 2012; Jelas et al., 2016). Scholars have found that learning engagement and learning motivation are often restricted by sense of learning incapability and sense of learning helplessness caused by learning disabilities in the learning process (Bewick et al., 2010; Cheng et al., 2011; Denovan and Macaskill, 2017). Thus, the emphasis of higher education lies in intensifying the positive psychological factors of students. Under the learning support from teachers and peers, the strong social relationship will improve psychological characteristics of students (Jelas et al., 2016), enabling students to recognize their own responsibilities and satisfy their needs for society and affection. Furthermore, if students are able to obtain support that is not provided for external students, they will be more willing to spend more time and devote more energy to learning, thus generating positive attitudes and SWB. Therefore, this study proposes H6:

H6: Learning support has a positive and significant impact on students' SWB.

Student Employability (SE)

In recent years, scholars have put more effort into employability-related research. The substantial technological, social, and economic changes that have occurred in recent decades (Abbas et al., 2015) have modified the concepts and operations of industrial organizations (Abbas and Sağsan, 2019) and HEIs across the world (Vermeulen et al., 2018). Hence, dynamic HEIs ensure the highest standards of human capital development, so that they can contribute to economic growth (Ahmed et al., 2015;

Baek and Cho, 2018). Through research situations and design of methods, and the integration of theoretical and practical analysis, scholars have studied the meaning of employability and the causality between employability and other factors (Hennemann and Liefner, 2010; Avramenko, 2012; Baek and Cho, 2018). Van Der Heijde and Van Der Heijden (2006) have argued that employability is the individual's appropriate application of competence (Blázquez et al., 2018), continuous acquisition and creation of essential work skills in order to accomplish all the tasks, and adaptation to internal and external labor market changes (De Cuyper et al., 2008; Vermeulen et al., 2018; Malik et al., 2019). Hence, the need for critical and reflective thinking, problem-solving abilities, self-management, learning, and related competencies is continually increasing across all disciplines (Makkonen and Olkkonen, 2017). Several prior studies have indicated that in addition to the influence of basic education on employability, factors like personal conditions, interpersonal relations, and external factors that cannot be acquired in higher education should also be considered (Ahmed et al., 2015; Cacciolatti et al., 2017; Blázquez et al., 2018).

Hennemann and Liefner (2010), who developed a graduate employability training process, summed up a comprehensive structure of impact factors to explain the capacity, capability, and competence (Blázquez et al., 2018) that are important elements in the process of developing employability (Hennemann and Liefner, 2010; Modestino, 2016; Lurie and Garrett, 2017; Blázquez et al., 2018; Likisa, 2018). De Cuyper et al. (2008) considers employability as having its importance in the post-industrial knowledge society by continuously updating knowledge to maintain competitiveness in a global market (Griffeth et al., 2005), and making them feel capable of dealing with temporary and future developments—new psychological contracts created by individuals will likely increase their well-being. In addition, individuals can process the same things and tasks more efficiently and in less time with relevant experience, updated skills and knowledge—as well as a well-developed social network—so as to improve employability (Griffeth et al., 2005). The abundance of time saved will be used for life needs and personal future planning, thereby enhancing happiness. Similarly, students with higher employability can face the challenges of the future with a broader perspective. In addition to mastering the content of school work, they also have a more precise direction for planning and preparation for entering the workplace, reducing their insecurity and enhancing SWB. Based on the above phenomena, the hypothesis of this study is as follows:

H7: SE has a positive and significant impact on students' SWB.

Self-Efficacy

Social cognition scholars argue that individuals' behavioral outcomes will be influenced by both environmental and cognitive factors in a given situation (Van Dinther et al., 2011), especially those beliefs that lead to success and behavior (Wang et al., 2016; Lent et al., 2014). They call these beliefs "self-efficacy," an important cognitive variable in personal factors during the process of interpreting individual formative behaviors, and interaction with the environment (Lent et al., 2014; Sheu et al., 2014). It can also be seen as the basis for human behavioral motivation, mental health and personal achievement (Dacre Pool and Qualter, 2013). Self-efficacy is widely used in the field of education to explore the psychological cognitive factors of students of different ages and their positive impact on academic achievement and student career development (Wang et al., 2016).

According to the above discussion, students who have confidence in their abilities will have more efficient behavior and better interpersonal relationships than those who do not. According to Dacre Pool and Qualter (2013), highly self-motivated students look for resources and opportunities to accomplish tasks that exist in social networks (Van Dinther et al., 2011). Only by establishing and maintaining network relationships can they achieve their goals. Knowledge and resources are needed (Lent et al., 2014; Sheu et al., 2014). Furthermore, teamwork can also be seen as a strong network relationship, and the process of students solving problems and achieving tasks through teamwork will positively affect their employability. It is pointed out that, according to the above, this study proposes the following H2:

H8: Self-efficacy has a positive and significant impact on SE.

Some scholars have focused their investigations on mental health concerns, social support, and coping styles in low SES college students (Song and Ingram, 2002; Tong and Song, 2004). However, few studies thus far have tapped this population's general self-efficacy and SWB (Evans et al., 2017). Tong and Song's (2004) research findings indicated that low-SES college students reported a lower level of social support, limited sources of support, and low perceived support (Song and Ingram, 2002). It implies that low-SES college students' general self-efficacy and SWB decrease because they are unable to receive timely and necessary psychological support when confronting stress. In addition, it might contribute to unique stressors. Conversely, students with higher self-efficacy have higher SWB (Evans et al., 2017). In summary, the study infers the following:

H9: Self-efficacy has a positive and significant impact on students' SWB.

Based on the above hypotheses, this study proposes the following research framework **Figure 1**.

METHODOLOGY

Sampling

The research sample in this study comprised undergraduates. Purposive sampling was adopted, since there are many mathematics departments in universities, and different universities have different theories on school management and different teaching characteristics. To understand whether the subject attributes would influence the research results, the different research variables between students majoring in natural sciences and those majoring in social sciences were verified. The results indicated that subject did not significantly

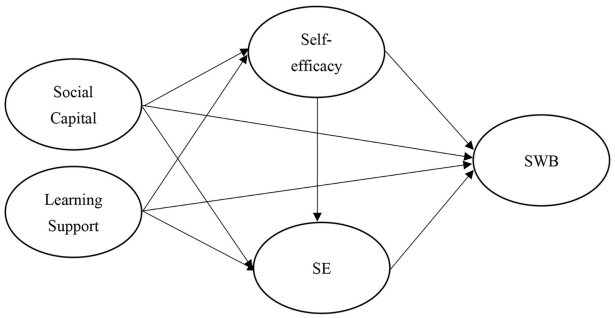

FIGURE 1 | Research framework.

impact the research variables, so did not need to be included as an independent variable in subsequent analyses. This study proposed a framework to explore the correlations and development mode of social capital, learning support, self-efficacy, SE and SWB. It sampled from Taiwanese and mainland China universities. This study also incorporates students' degree as a sampling condition, as freshmen were left out of sample. This study selected 12 Taiwanese universities and 6 mainland China universities, and then sent 2,000 questionnaires to each of them. The researchers contacted with the colleges and teachers who were willing to receive the questionnaire by telephone and email first. The survey packages were sent by post to students of 18 universities. Each survey package contained a covering letter explaining the survey purpose, a survey instrument and a postage-paid envelope. Before filling out the questionnaires, students have been asked to understand the right of attending survey to ensure research ethical aspects. The students voluntarily completed the questionnaires, after signing their informed consent. During the school year (2020.03–2020.04), students completed the questionnaire. After sampling, a total of 646 Taiwanese questionnaires and 537 mainland China questionnaires were returned, for an effective response rate of 64.6 and 53.7%. Since freshmen were not familiar with the learning process, participants were sophomores, junior and senior students.

Measures

All constructs were measured by multiple-item scales based on previous studies. The construct of social capital was divided into student–faculty interaction and interpersonal environment. This study adopted the scale proposed by Pike et al. (2012). Student–faculty interaction was measured using four items, and interpersonal environment was measured using three items. The construct of learning support was divided into peer supportiveness (3 items) and teacher supportiveness (3 items). This study adopted the scales proposed by Pike et al. (2011). Similar to the employability scale reported by Pan and Lee (2011), eighteen items were used to capture general ability for work (GAW) (8 items), professional ability for work (PAW) (4 items), attitude at work (AW) (3 items) and career planning and confidence (CPC) (3 items). For self-efficacy, six items were selected on the basis of prior scale and item analyses of Asian applications (Rigotti et al., 2008). Subjective Well-being was measured using Keyes's (2005) Subjective well-being instrument (adolescent version), which comprehensively assesses well-being in terms of emotional (3 items), psychological (4 items) and social (4 items) dimensions. All items were measured with a five-point Likert scale (1 = totally disagree; 5 = totally agree).

RESULTS

Sample Description

After sample collection, backgrounds of Taiwanese and mainland China samples in **Table 1** are arranged in this study. Before conducting model verification, we have verified that whether different backgrounds vary in SWB. In this study, the independent samples t-test and one-way analysis of variance were applied to compare differences of gender, part-time job, scholarship, first-generation college student, majors, dedication to class preparation and weekly study hours spent on major courses on students' SWB in Taiwanese and mainland China samples. Results show that when it comes to weekly study hours spent on major courses, significant differences occur in students' SWB. Thus, when conducting model verification, sample backgrounds will not be added in this study. **Table 1** shows descriptive statistics of Taiwanese and mainland China samples.

Reliability and Validity

All scales used in this study were found to be reliable, with Cronbach's α ranging from 0.83 to 0.96. **Table 2** shows the reliability of each scale, and the factor loadings for each item therein. In order to gauge validity, this study employed confirmatory factor analysis (CFA) using AMOS 23.0 to verify the construct validity (both convergent and discriminant) of the scales. According to Hair et al. (2006) recommended validity criteria, CFA results show standardized factor loading of higher than 0.7; average variance extracted (AVE) ranges between 0.539 ∼ 0.729; and composite reliability (CR) ranges between 0.800 ∼ 0.918. All three criteria for convergent validity were met, and correlation coefficients were all less than the square root of the AVE within one dimension, suggesting that each dimension in this study had good discriminant validity.

The Structural Model Fit of SEM

Social capital, learning support, SE and SWB are often higher-order constructs in nature, with items measuring them as indirect reflective measures of both second- and first-order factors associated with them, where the social capital, learning support, SE and SWB are umbrella terms for multiple sub-constructs. Social capital is often conceptualized as a two-dimensional construct, learning support as a two-dimensional construct, SE as a four-dimensional construct, SWB as a three-dimensional construct. Five constructs comprised the final model: social capital, learning support, self-efficacy, SE and SWB. This study adopted first-order constructs to assess structural model. Fit indices greater than 0.90 benchmark (GFI = 0.949, AGFI = 0.915, TLI = 0.945, and CFI = 0.963) indicated data fits said model.

TABLE 1 | Descriptive statistics by Taiwanese and mainland China samples.

Characteristic	Scale	Taiwan		Mainland china	
Gender	Male	310	−0.453 ($p > 0.1$)	329	−1.060 ($p > 0.1$)
	Female	336		208	
Part-time job	Yes	389	1.364 ($p > 0.1$)	343	0.661 ($p > 0.1$)
	No	248		194	
Scholarship	Yes	287	−0.250 ($p > 0.1$)	215	0.492 ($p > 0.1$)
	No	357		322	
First-generation college student	Yes	410	0.052 ($p > 0.1$)	372	0.995 ($p > 0.1$)
	No	236		165	
Majors	Social science	355	−0.137 ($p > 0.1$)	264	1.198 ($p > 0.1$)
	Natural science	291		273	
Dedication to class preparation	Yes	352	−0.899 ($p > 0.1$)	332	−0.773 ($p > 0.1$)
	No	294		205	
Weekly study hours spent on major courses	Less than 5	421	6.289 ($p < 0.01$)	186	3.434 ($p < 0.01$)
	5 to less than 10	93		136	
	10 to less than 15	52		107	
	15 to less than 20	36		87	
	More than 20	44		21	

TABLE 2 | Measurement properties.

		1	2	3	4	5	6	7	8	9	10	11	12
1. Interaction		0.87/0.71	0.53	0.32	0.54	0.00	0.08	0.06	0.04	0.02	0.01	-0.02	0.00
2. Interpersonal		0.65	0.76/0.77	0.32	0.42	−0.03	0.07	0.05	0.05	0.02	−0.07		
3. Peer		0.34	0.41	0.82/0.72	0.58	0.11	0.12	0.05	0.07	0.01	0.02	−0.08	−0.03
4. Teacher		0.42	0.57	0.63	0.89/0.71	0.13	0.04	0.05	0.08	0.03	0.02	−0.03	−0.03
5. Self-efficacy		0.40	0.49	0.47	0.51	0.79/0.76	0.09	0.11	0.12	0.11	0.28	0.29	0.32
6. GAW		0.44	0.53	0.43	0.51	0.50	0.74/0.71	0.13	0.14	0.10	0.01	0.07	0.07
7. PAW		0.40	0.44	0.41	0.49	0.49	0.70	0.79/0.77	0.62	0.63	0.13	0.08	0.13
8. AW		0.42	0.53	0.51	0.54	0.55	0.71	0.74	0.75/0.73	0.70	0.19	0.13	0.19
9. CPC		0.49	0.49	0.43	0.49	0.56	0.65	0.64	0.73	0.82/0.84	0.16	0.14	0.17
10. Emotional		0.39	0.48	0.41	0.44	0.56	0.40	0.38	0.48	0.44	0.87/0.77	0.74	0.61
11. Psychological		0.45	0.52	0.46	0.54	0.69	0.51	0.48	0.52	0.51	0.79	0.81/0.75	0.71
12. Social		0.53	0.52	0.43	0.48	0.62	0.47	0.44	0.51	0.50	0.68	0.72	0.84/0.77
Mean	Taiwan	3.22	3.56	3.72	3.80	3.75	3.54	3.63	3.61	3.55	3.63	3.71	3.52
	China	3.59	3.23	3.63	3.63	3.95	3.71	3.88	3.93	4.01	4.40	4.47	4.58
SD	Taiwan	0.81	0.70	0.69	0.71	0.63	0.64	0.70	0.69	0.72	0.72	0.69	0.77
	China	0.58	0.72	0.59	0.55	0.40	0.63	0.72	0.69	0.71	0.51	0.49	0.50
α	Taiwan	0.93	0.80	0.86	0.92	0.91	0.90	0.87	0.78	0.86	0.90	0.88	0.90
	China	0.78	0.81	0.68	0.64	0.77	0.75	0.85	0.76	0.88	0.78	0.81	0.85
AVE	Taiwan	0.76	0.58	0.68	0.80	0.62	0.55	0.63	0.57	0.67	0.75	0.65	0.71
	China	0.51	0.59	0.52	0.51	0.58	0.50	0.60	0.53	0.71	0.60	0.57	0.59
CR	Taiwan	0.93	0.81	0.87	0.92	0.91	0.91	0.87	0.80	0.86	0.90	0.88	0.91
	China	0.78	0.81	0.77	0.76	0.84	0.79	0.85	0.77	0.88	0.81	0.83	0.84

Similarly, levels of misfit were tolerable, with RMSEA = 0.054 and RMR = 0.033, which RMSEA and RMR were below the relevant benchmark of 0.08. Additional tests included normed chi-square of 2.57 (less than benchmark of 5) and SRMR = 0.035 (less than benchmark of 0.08).

Figure 2 shows the results of the hypothesized relationships and standardized coefficients. This study finds that social capital relation has positive effects on self-efficacy (β = 0.187, $p < 0.01$), SE (β = 0.206, $p < 0.001$), and SWB (β = 0.101, $p < 0.05$), the learning support relation would be positively associated with self-efficacy (β = 0.323, $p < 0.001$), SE (β = 0.100, $p < 0.1$) and SWB (β = 0.146, $p < 0.01$), the self-efficacy would be positively associated with SE (β = 0.370, $p < 0.001$) and SWB (β = 0.513, $p < 0.001$), the SE relation has a positive effect on SWB (β = 0.297, $p < 0.001$). Accordingly, H1, H2, H3, H4, H5, H6, H7, H8, and H9 were acceptable and supported.

The model proposed in this study assumed that self-efficacy and SE would mediate the relationship among social

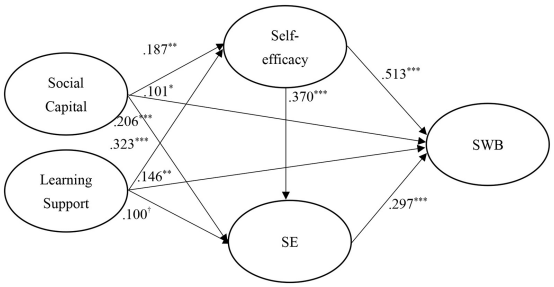

FIGURE 2 | Structural model. †$p < 0.1$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

capital, learning support and SWB. This study further tests for mediation following the approach proposed by Sobel (1982). In above structural model, mediation results indicated that social capital → self-efficacy → SWB ($Z = 2.830$, two-tailed probability $p < 0.01$), social capital → SE → SWB ($Z = 3.125$, two-tailed probability $p < 0.01$), learning support → self-efficacy → SWB ($Z = 4.935$, two-tailed probability $p < 0.001$), and learning support → SE → SWB ($Z = 1.776$, two-tailed probability $p < 0.1$) were positively significant. Therefore self-efficacy and SE have full mediations on social capital and learning support toward SWB.

Multiple Group Analysis: Taiwan and Mainland China

It was confirmed that the measurement pattern was stable. However, in order to avoid overgeneralizing the data-driven patterns and theories, the study followed the suggestion of Hair et al. (2010) to divide the sample data into two groups based on regions (646 Taiwanese and 537 mainland China students, respectively). Besides, multiple group testing was combined with bootstrapping to gradually control the pattern parameters of the groups. The nested models developed from the different limitations χ^2 difference quantity to make significance analysis, in order to determine the reasonability of those parameters in controlling the two groups. The results are shown in **Table 3**.

The analysis results show that the value of each pattern mode of χ^2/df ranged from 3.096 to 7.004, the RMSEA ranged between 0.042 and 0.071 and the ECVI was within 90% of the confidence interval. It can be learned from **Table 2** that the χ^2 values of the weighted measurement model, weighted structure model, covariance structure model and residual structure model reached significant levels, which shows that the models had good between-groups invariance. In addition, the NFI added value of each model was less than 0.05, which is in accordance with the standard recommended by Little (1997). Therefore, the framework and conclusion of this research will present good generalized validity.

The standardized structural weights for Taiwanese and mainland China students are shown in **Figures 3**, **4**, respectively. Specifically, in structural model of Taiwanese students, all paths had significantly positive effects except the effect of SE on SWB. However, comparing to Taiwanese students, in structural model of mainland China students, social capital and learning support appeared to have no significant effects on SE and SWB. This suggests that the Taiwanese students achieved greater SWB development from having well-established social capital and learning support.

However, the results showed in both model that self-efficacy may play a significant mediating role in the relationship among social capital, learning support, SE and SWB. These findings regarding region differences support our study's purpose with regard to identifying the region-specific pathways to students' SWB.

DISCUSSION AND CONCLUSION

This study takes Taiwanese and mainland China students as research samples to test the social capital, learning support, self-efficacy, SE and SWB correlation using the social cognition theory. This study will fill the theoretical gap in the application of Western theories under the Eastern context, and increase the generalization of the theory. Based on our research findings, this study aims to provide following contributions. First, there are few studies to verify students' learning based on a huge environmental challenge. This study investigates universities students' learning process and SWB in the situation of Global Pandemic of COVID-19 and attempt to offer practical implications for institutional administrations. Second, most previous studies on SCT explored the importance of

TABLE 3 | Multi-group testing.

Model	χ^2	*df*	χ^2/df	*p*	RMSEA	NFI	ECVI	0.9 CI
1. Unconstrained	650.156	210	3.096	0.000	0.042	0.946	0.713	(0.713 ~ 0.781)
2. Measurement weights	889.387	222	4.006	0.000	0.05	0.926	0.895	(0.821 ~ 0.976)
3. Structural weights	1110.552	229	4.85	0.000	0.057	0.908	1.071	(0.986 ~ 1.162)
4. Structural covariances	1162.203	232	5.009	0.000	0.058	0.904	1.109	(1.022 ~ 1.203)
5. Structural residuals	1240.539	235	5.279	0.000	0.06	0.897	1.171	(1.080 ~ 1.267)
6. Measurement residuals	1764.892	252	7.004	0.000	0.071	0.854	1.586	(1.476 ~ 1.702)
2–1	239.231	12		0.000		0.020		
3–1	460.396	19		0.000		0.038		
4–1	512.047	22		0.000		0.042		
5–1	590.383	25		0.000		0.049		
6–1	1114.736	42		0.000		0.092		

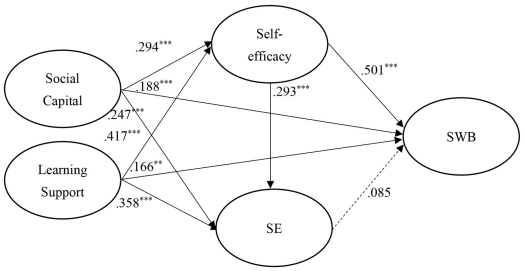

FIGURE 3 | Structural model on Taiwanese students. $^{**}p < 0.01$; $^{***}p < 0.001$.

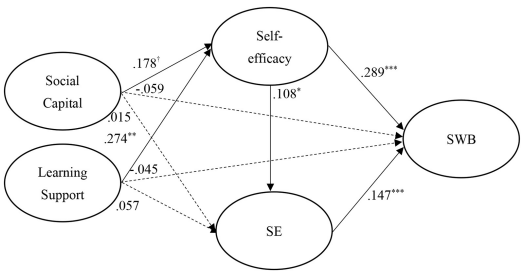

FIGURE 4 | Structural model on mainland China students. $^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

environmental factors but merely few studies provided essential contributions with global environmental factors. This study aims to fill the theoretical gap and enrich theoretical foundation of SCT. Third, in addition to verifying the research framework built through SCT in Asian context, this study also includes different perspective of conventional learning (conventional vs. online learning). Our findings will provide more insights and suggestions in terms of learning theories.

The results indicate that the social capital and learning support of Taiwanese students are positively related to their employability, whereas there have no significant effects on mainland China students. These results correspond with those of Cupani et al. (2010); Wu et al. (2010), and Lent et al. (2016); on the basis of SCT, they believe that the learning environment differences between conventional and online learning influence students' learning status and learning activities, causing knowledge and skills-gaining to differ. Our findings are largely consistent with those of these prior studies, supporting the SCT model's availability across a range of regions. Besides, there may be insignificant correlations among social capital, learning support and SE on mainland China students because students can not acquire sufficient employment information leaded by economic activity stagnation which fosters suitable employability.

Moreover, the results show positive correlations among social capital, learning support and self-efficacy for both Taiwanese and mainland China students. It is also worth noting that the internal and external learning support mechanism imply that students with more social capital and learning support from peer/teacher are likely to be more involved in the learning environment and actively participate in learning activities, thus obtaining ability and confident of achieving course task, such as the development of systematic/integrative thinking and problem-solving skills. This finding is consistent with the findings of a number of previous studies (Pike et al., 2012; Wu et al., 2012; Bocanegra et al., 2016), supporting the relationship among social capital, learning support and self-efficacy.

Besides, our findings show that social capital and learning support of Taiwanese students are positively related to their SWB, whereas there are no significant effects on mainland China students. Although the results are consistent with argument of Lent et al. (2016) that traits may function along with psychological and essential factors in the maintenance of SWB, limitations of environmental trait may produce differences, such as freedom degree of learning and behavior. A majority of mainland China students learn on scientific media, the learning outcomes are inconsistent with Cheng et al. (2011), and Jelas et al. (2016), i.e., more learning supports fail to result in better SWB. The possible reason may be that Cheng et al. (2011) failed to measure the psychological factors of learners arising from the external environmental threats, and higher emotional, psychological and social well-being cannot be formed despite of higher degree of usage and acceptance of information technology.

Finally, the findings show that self-efficacy and SE are strong contributors to SWB for both Taiwanese and mainland China students. Furthermore, self-efficacy plays a key mediating role in the research model of SCT. These findings are quite consistent with those of Sheu et al. (2014) and Lent et al. (2016), who verified the well-being model cross-sectionally in different samples of college students. Moreover, different from the study of Sheu et al. (2014), this study compares samples of different regions in the same model, such as Taiwanese and Singaporean college students, reports good overall model-data fit in both samples (Taiwan and mainland China), and verifies direct and indirect effects of self-efficacy generated in well-being model of SCT on SWB. However, differing from the studies of Sheu et al. (2014) and Lent et al. (2016), this study also considers psychological effects of global environmental events, and enriches the theoretical model and SCT of well-being based on the region analysis.

Practical Implications

In sum, according to our findings, this study suggests some important practical implications for improving quality of higher education. Firstly, in this study, the teachers and peers supportiveness and social capital were perceived as equally important and predictive of students' own perceived levels of self-efficacy, SE and SWB. Internal and external building mechanism of mentality will contribute to students obtaining more resource and psychological supports, which are essential conditions for improving SWB. Thus, at the present stage when countries and regions all over the world combat COVID-19, in face of similar events, institutional administrations should encourage teachers to actively form a close ties with students, build communication platform using technological media and information technology tools, and provide schoolwork or psychological support in real time. Students are afraid and worried about catching the virus, but mainly because they think they can infect their family, specifically in mainland China, and this makes them avoid

external contacts in learning. Moreover, the lockdown situation has produced conflicting emotions in the students. On the one hand, they are scared, nervous, lonely, sad, bored and angry, but they also feel safe, calm and happy with their families. These phenomena may use to explain why social capital and learning support were insignificant with SE and SWB.

Second, external environment factors, especially the global epidemic COVID-19, may affect student learning status. Thus, school administrations must be examined for a sense of risk management. On this basis, this study suggests institutional administrations to take preventive risk management measures to tackle with threats and challenges brought by adaptive risks in face of similar events. Although this event causes all students to take online class, not all students are equipped with the required technological media or information technology tools. In consequence, schools should count up the number of students who have information technology tools at first and measure whether courses are able to be taught online; and the courses that are not suitable for online teaching should be adjusted in terms of schedule. On this basis, this study suggests that course should be modified and transferred to the next semester if the online courses have low teaching results or fail to achieve the expected learning outcomes.

Third, in light of the structural patterns of two regions, SWB deriving from self-efficacy of Taiwanese students is superior than that of students in Mainland China. It can be seen that opening schools or not will both have an effect on students. Students in regions that are blocked for longer time tend to feel more helpless, incapable and anxious. The limitations of environmental traits, the difference among learning modes, life modes and interpersonal relationship, etc. caused by COVID-19 would have more effect on their lives and plan, such as the cancelation of GRE, TOEFL, IELTS in February and March will affect their applications for abroad studies in near future, etc. These results indicate the need for Governments to also consider college students in their management of the current situation by placing greater emphasis on social and inclusive policies to help alleviate the possible effects that they may suffer as a consequence of the pandemic and the lockdown.

Research Limitations

The research results contribute to the literature on region-specific students, SCT, and student well-being; nevertheless, some limitations still exist and represent further research directions. First, social cognitive theory has obtained considerable status in the psychological field, but only a few studies have considered the relationship between building mechanism and well-being of undergraduate students in higher education. Although the building mechanism (social capital and learning support) was constructed with reference to SCT in this study, and important learning theories can be derived from the research results, other motivation theories, such as attribution theory, self-efficacy theory, and hierarchy needs theory, still apply to explain how to trigger learning in region-specific students. Thus, it is suggested that future research can utilize different theoretical models in order to identify relevant psychological dimensions influencing students' well-being. Second, this study required students to self-report details on their psychological building mechanism as the indicator, mainly because actual data is confidential and not easily obtained. However, errors may exist in the students' self-statement of their psychological status. The link between building mechanism and well-being may be better understood if students' actual psychological status is assessed, with due consideration for research ethics. It is an exploratory study to some extent. The SCT model is adopted in the context of COVID-19 to explore the relationship between various variables in the process of student learning, and a comparison of model is further conducted in different regions. Thus, it is difficult to review more previous research results of the same context. For the sake of increasing more theoretical contributions, this study suggests that future researchers can conduct similar model validation in the post COVID-19 period to confirm the changes in the relationship between variables in different situations, so as to provide more abundant insights and implications.

Besides, this study suggests future researchers to include interview contents and students' observations of learning status in their studies to support the researching results and make a comprehensive judgment. Third, due to restrictions of time and space, only 16 universities were sampled in this study, with 817 valid questionnaires in total. The research objects were divided into Taiwanese and mainland China students. Future research could explore and compare other groups, in addition to expanding the quantity of samples and improving the research representativeness, so as to provide additional insights relevant to higher education policy.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board, University of Taipei. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MP and PX contributed to the ideas of research, collection of data, and empirical analysis. MP and PX contributed to the data analysis, design of research methods, and tables. MP and MA participated in developing a research design, writing, and interpreting the analysis. All authors contributed to the literature review and conclusions.

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METHODS
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An Innovative Approach for Online Neuroanatomy and Neurorrehabilitation Teaching Based on 3D Virtual Anatomical Models Using Leap Motion Controller During COVID-19 Pandemic

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After the World Health Organization had declared a pandemic of coronavirus disease (COVID-19) on March 11, 2020 many governments, including the Government of Spain, declared the state of alarm enforcing a quarantine that have left millions of students confined to their homes. This home confinement has affected students of all levels, including university students, and has forced faculties to adapt online teaching strategies. Thus, traditional classroom face-to-face teaching has suddenly been replaced by online classes. This has revealed particularly challenging for medical courses. For such purpose we have designed an online teaching proposal addressed to the Degree in Physiotherapy and the Double Degree in Nursing and Physiotherapy of the University of Jaén (Spain). The objective is to implement an online virtual teaching protocol through the use of Virtual Reality. For such a goal, the Leap Motion Controller (LMC) will be used to teach the neuroanatomy of the brain and spinal cord and to teach and practice neurorehabilitation exercises. Along with devices like the LMC students will be asked to use Health Sciences databases in order to achieve a significative learning of the course topics. The project is structured in two phases. First, students will learn neuroanatomy and neurophysiology of the most relevant neurological conditions using LMC-based models. Then, they will learn to combine LMC games and conventional physiotherapy for neurorehabilitation purposes. The work of students will include the recording of videoreports demonstrating the acquisition of neuroanatomy concepts and simulating a clinical case. With this project we will assess the usability of LMC as an educative tool, the perception, satisfaction and self-regulated learning of physiotherapy students.

Keywords: leap motion controller, virtual reality, physiotherapy, distance learning, COVID-19, home confinement, neuroanatomy, neurorehabilitation

INTRODUCTION

Impact of COVID-19 in University Health Sciences Teaching and Learning

The World Health Organization (WHO) country office in China, reported the first case of the new coronavirus "COVID-19 (SARS-CoV-2) in Wuham (China) on December 31, 2019 (Ammar et al., 2021). Consequently, the global irruption of COVID-19 at the beginning of 2020 has caused a health alarm considered as pandemic by the WHO on March 11, 2020 (Sohrabi et al., 2020). The virus spread quickly around the world causing a large number of intensive care hospitalizations and deaths of older people (Devaux et al., 2021). With the aim to reduce the curve of contagions and deaths, health authorities of most countries established social distancing measures between population (de la Fuente et al., 2021) and declarated a home confinement and quarantine (Jiang et al., 2020) that has been the most severe disruption of normal lifestyles in history (Hossain et al., 2020).

This home confinement forced to interrupt face-to-face teaching in schools, institutes and universities (Stokes, 2020). Face-to-face teaching has been canceled in order to promote social distancing, limiting the risk that students contract the COVID-19, and become foci of infection which spread to the healthcare teaching staff who could be assigned to fight COVID-19 (Newman and Lattouf, 2020). This has caused that theoretical and practical training in healthcare courses, as well as the assessment of students' achievements must be done at their homes (Elearning; Yang et al., 2021), adopting a new relationship between teachers and their students (Wang et al., 2020). Online teaching has been proposed as the main method for home learning (Aziz Ansari et al., 2021; Pilkington and Hanif, 2021). Although home learning is effective to reduce COVID-19 infections, it has caused devastating effects in students' physical, emotional and social life (Cachón-Zagalaz et al., 2020; López-Castro et al., 2021). Students have showed a reduced level of physical activity during the quarantine and an increased level of psychological overload due to anxiety (García-González et al., 2021), depression (Cao et al., 2020), mood disturbance, irritability (Kostiæ et al., 2021), stress (Znazen et al., 2021), nervousness and sleep disorders (Saadeh et al., 2021), among others (Feng et al., 2021; Lavigne-Cerván et al., 2021). Related with the home confinement in education, a decreased level of attention and motivation has been reported by students during home confinement due to the difficulties to perform a normal teaching-learning process at home (Prado-Gascó et al., 2020; Zaccoletti et al., 2020). The lack of computer resources and the lack of face-to-face monitoring may be two main causes of poor academic performance during the confinement. However, to reduce students discomfort, different authors have reported the positive emotional effects of home physical exercise or active lifestyle during quarantine (Bentlage et al., 2020; Chtourou et al., 2020), which can also increase academic performance during COVID-19 (Bentlage et al., 2020).

Students of different Health Sciences, such as Medicine, Physiotherapy, Nursing or Psychology must learn multiple contents of neuroanatomy and clinical management of the most prevalent neurological diseases. Usually, these contents are learning at university laboratories and classrooms through face-to-face practical sessions in which models, corpses and role-play simulations are used. However, due to the health alarm and quarantine status the academic staff has been required to adapt their teaching taking advantage of the possibilities of tools like Virtual Reality (VR). In this sense, teachers must encourage the use of new technologies that permit students keep receiving the best possible training. Different studies have applied digital technologies to promote distance-education before COVID-19 pandemic with promising results. Besides, recent studies have showed positive psychosocial effects of the use of communication technologies during home teaching and during home physical training during home confinement (Souissi et al., 2021).

The Importance of NeuroEducation in Physiotherapy

Anatomy learning is essential for the training of healthcare professionals, specially physiotherapist (McLachlan and Patten, 2006). Neuroanatomy defines as the science that studies the macroscopic (histology, cytology, and cell biology) and microscopic structures of the Nervous System (NS), which is composed by the Central Nervous System (CNS) and the Peripheral Nervous System (PNS) (Arantes et al., 2018). Neuroanatomy stands as one of the most difficult subjects for students (Arantes et al., 2018). One reason is the complexity of the study contents related to the CNS and PNS, which include the pathways involved in each neurophysiological process. The other reason is the shortage of anatomical tools, including neuroanatomy models, handbooks or software at universities. For these two reasons it is imperative that teachers pre-explain or provide instructions to students along with the study material (Yammine and Violato, 2016). During the quarantine period, it is essential to facilitate access to new tools that help Physiotherapy students in the learning of neuroanatomy. In addition, the emotional coping of students toward the psychological consequences of confinement can entail a loss of meaningful learning of anatomy and therapeutic contents, resulting in an academic training gap that will affect their subsequent clinical practice (Brooks et al., 2020). Social and educational isolation affecting the study (Zhai and Du, 2020) are key barriers that must be overcome through the implementation of new technologies for the study of anatomical content.

An exhaustive study of neuroanatomy and neurophysiology, as well as the most prevalent neurological disorders, their clinical manifestations and their therapeutical management is essential for the correct training of students as future physiotherapists. The success in the subsequent clinical practice is related to the training process in the university. In this sense, the COVID-19 pandemic precludes normal face-to-face teaching in the traditional classroom setting and impedes an adequate practice. Teachers must do an effort using available technologies to provide

quality instruction of neuroanatomical contents during home confinement.

New Technologies Applied to Neuroanatomy Teaching in Health Sciences: Epistemological Development

In the last two decades, a considerable increase in the use of new teaching tecnhonologies and tools has enabled the emergence of Digital Education (DE) (Martinengo et al., 2020). DE is "the fact of teaching and learning through digital technologies" (Car et al., 2019) which happens in a number of situations and scenarios such as electronic resources, offline and online education, games-based learning and virtual reality environments that allow teaching or acquisition of professional practice skills (Martinengo et al., 2019). The use of projected images, tablets, or smartphones have enabled the view of the most important neuroanatomical structures and has allowed a visual understanding of the complexity of cerebral structures (Wainman et al., 2018). However, these technologies provide 2D views and do not allow the students see neuroanatomical structures from a three-dimensional perspective, showing their size and volume. During the time of home confinement is necessary to use other digital tools that provide an immersive view and allow students interact with neurological contents, as well as a bidirectional online communication between students, their mates and teachers. That is, a virtual classroom that substitutes traditional neurology and physiotherapy teaching.

Virtual Reality (VR) technology allows teaching and interaction in a reproducible and controlled environment (Bennett and Saunders, 2019). This technology provides multisensory training and immersion (Pothier et al., 2012) in learning contents, so VR can become the perfect ally for teaching neuroanatomy during home confinement. VR increases educational possibilities in the classroom, adding a new dimension to the pre-established study program. It also enables an interactive virtual environment that makes possible students develop their own experiences and interact with learning materials (Zhao et al., 2020). Finally, and most importantly, VR ease the study of abstract contents in a graphical way.

Among a number of different VR devices, the Leap Motion Controller (LMC) (Ultraleap Ltd, 2020) has been used as a neurorehabilitation and teaching tool (Partridge et al., 2016; Sun et al., 2017). LMC is a consumer-grade, contact-free interaction and low-cost VR device designed to capture the movements of human hands and fingers (Niechwiej-Szwedo et al., 2018). It can be plugged into the USB port of a computer (Bachmann et al., 2018) and does not require to place sensors on the participant's body (Bachmann et al., 2018). LMC allows tracking the position of the arms, wrists and hands of up to four people (Oña et al., 2018). This device includes three infrared sensors and two cameras for hand recognition (Fonk et al., 2021). LMC presents some advantages such as its small size, it is easy to use and install and can be used with different applications for physical rehabilitation (Placidi et al., 2018; Fernández-González et al., 2019; Cortés-Pérez et al., 2021; de los Reyes-Guzmán et al., 2021). Regarding the employment of LMC in teaching LMC allows the interaction of the user's hands in a three-dimensional environment through different applications (Yang et al., 2020), including videogames. Thus, LMC is postulated as a reliable and valid tool for neuroanatomy teaching and eLearning. Different videogames allow students can select a neuroanatomical region from a virtual model and move it, flip it, or zoom in or out in the 3D space. It also permits students visualize the interior of a structure, which would be impossible in a 2D viewing. This increases the teaching realism and meaningful learning thanks to a full interaction with neuroanatomical virtual models. According to this, several authors have analyzed the use of VR and LMC in anatomy teaching and training of surgical and healthcare procedures (Ferreira dos Santos et al., 2016; Yeo et al., 2018; Kyaw et al., 2019; Alvarez-Lopez et al., 2020), or engineering training among others (Häfner et al., 2013). After using LCM, students reported that it was a useful, easy-to-use and effective device for anatomy learning, highlighting its precision for hand and finger recognition (Nainggolan et al., 2016). In addition, other forms to develop the elearning can be considered with promising results (Nieto-Escamez and Roldan-Tapia, 2021), such as gamification using VR (López Chávez et al., 2020; Vermeir et al., 2020) or without VR (Gutiérrez-Puertas et al., 2020; Molina-Torres et al., 2021).

Currently, there is scientific evidence supporting the use of VR devices in teaching and learning processes. It has been shown that it boosts students' imagination, creativity and significative learning (Herrera et al., 2006). Various studies in neuroeducation have suggested that visual materials favor the development of brain schemas, improving long-term memory capacity and meaningful internalization of learning concepts. It has been reported that students perceive that using VR in classroom makes teaching more enjoyable and attractive, and increases their participation of Vishwanath et al. (2017). Other studies emphasize the fact that teaching through VR promotes constructivism (Alhalabi, 2016), increasing significant learning and improving analytical thinking thanks to cognitive modifications associated to the use of more complex tools (Passig et al., 2016). A recent meta-analysis reinforces the idea that didactic interventions with VR produce a positive effect on the expected results and increases students' significant knowledge. Moreover, compared with 2D digital methods, VR can improve the effectiveness of teaching in anatomy curses (Zhao et al., 2020). Therefore, VR and especially the LMC is postulated as a useful and plausible tool for studying Health Sciences courses at home, such as neuroanatomy in the degree of Physiotherapy. In addition, it has been reported that 90% of students agree with the use of 3D visualization techniques applied to neuroanatomy courses and believe that they provide a more effective learning (Nainggolan et al., 2016).

Emotion and Self-Regulated Learning, Cognitive, and Emotional Variables

The majority of studies in educational areas have mainly focused on the cognitive processes of students, leaving the emotional processes in a second level (Frenzel et al., 2018). Perhaps, this is because teaching has traditionally focused on students' cognitive

and behavioral development to assimilate a large amount of information (Barajas and Gannaway, 2007). However, emotions associated with the events experienced by the students can make easier to remember what has been studied whereas learnings remain for longer in their memory. The use of experiences that students feel as favorable and respond to their interests will facilitate the development of positive emotions (for example, fun, pride, and confidence), leading to a facilitation of the memory and knowledge linked to such events (Pell et al., 2009). Conversely, negative emotions (e.g., boredom, anxiety, frustration) interfere with and may even inhibit the recall, as it makes difficult to store information into memory and retrieve it during the task performance, impairing learning (Di Gesú and Seminara, 2012). If we also consider distance teaching, it has been reported that it requires high levels of motivation (Morris et al., 2005).

Additionally, people exposed to social isolation and quarantine have an unpleasant experience (Brooks et al., 2020), so the current situation due to COVID-19 may also have negative psychological consequences (Brooks et al., 2020; Wang et al., 2020). The motivation of students may be affected with the lack of contact with classmates, teachers and professionals in training centers, leading to a deterioration of their interest and satisfaction levels (Balaban-Sali, 2008). For instance, it has been reported a direct relationship between the quality of online teaching and students satisfaction (Palmer and Holt, 2009). It is therefore necessary to assess student satisfaction as a measure of the quality of remote learning.

It is also necessary to bear in mind that remote learning entails a component of self-regulated learning, which is made up of three components: metacognitive strategies (planning, supervision and regulation of one's own cognition), control and management of one's own effort, and cognitive strategies (referring to cognition itself; Pintrich and De Groot, 1990). This project will therefore pay special attention to resources control and management strategies, as well as to metacognitive strategies by students in home learning situation. For that reason, it is necessary to study the learning process itself, particularly the type of strategies that students develop in self-regulated learning.

Justification of This Project

Healthcare professionals working with patients suffering from neurological disorders, especially physiotherapists, need to know the structure and anatomy of the Central and Peripheral Nervous Systems; as well as the most prevalent and physically disabling neurological diseases, along with conventional therapies for their treatment. In recent years, the advances in the field of neurorehabilitation have led to the introduction of VR devices for the treatment of these patients. In this sense, knowing coadjuvant techniques for rehabilitation together with the traditional procedures becomes essential. Physiotherapy students must continue their training during the period of quarantine and teachers must find new solutions to promote distance teaching and meaningful learning at home. Moreover, in order to generalize and establish the psychoeducational foundations for the use of VR tools in online Physiotherapy learning it is essential to know and assess how it affects students' satisfaction and their motivational, cognitive, metacognitive, resources control and management strategies.

PEDAGOGICAL FRAMEWORK

This e-learning proposal has been designed for the course *"Specific Methods of Intervention in Physiotherapy III"* in which the LMC device will be employed for the study of neuroanatomy and the main clinical manifestations of prevalent neurological disorders (stroke, multiple sclerosis and Parkinson diseases among others) susceptible of receiving Physiotherapy treatment. LMC will help students develop a realistic online training and will promote significative learning of neuroanatomy and neurorehabilitation. This project will be implemented as a pilot in one group of students who will receive a LMC and the results will be compared with an equivalent group of students enrolled in the same course who will receive more traditional online learning.

Methodology

The proposed project will start with an initial introduction about LMC. In these pre-initial instructions about LMC, teachers will do a search in Health Science databases (Medline PubMed, Scopus, Web of Science or PsyCINFO ProQuest, among others) to show students how LMC can be used in neuroanatomy learning and neurorehabilitation training. The University of Jaen offers the possibility of using digital platforms for bidirectional online communication between students and teachers. Students will have access to documentation and one LMC at home for the entire duration of the course. A work schedule similar to the official teaching guide will be available to them.

Learning contents included in this course focus on the study of different neurological disorders, and their neuroanatomical correlates and main clinical symptoms. In this order, students will receive training about stroke, acquired brain injury, multiple sclerosis, spinal cord lesions, and neurodegenerative disorders such as Alzheimer or Parkinson disease. Each pathology will be developed as a learning unit. The learning model for each learning unit will be organized in periods of 2 weeks according to the following schedule:

1. **Common Pre-initial Phase**: Before teaching starts, every student will receive one LMC device by postal service. Students must sign a device cession deal with the University of Jaen. At the same time, teachers will send an e-mail to students with the instructions about the use of the LMC device. In this phase, students will learn the initial use of LMC, how to install and update it, and the required software. Teachers will provide an access code for differents 3D anatomy softwares and VR neurorehabilitation games to be used in each course unit.
2. **Neuroanatomical and Neuropathology Teaching Phase (Week 1)**: For every learning unit, teachers will provide online theoretical contents about the selected pathology and its neuroanatomy during the first week. *Google's Gsuite*

Meet platform will be used for online classes. Students work will consist in reviewing theoretical contents about neuroanatomy and neurophysiology using LMC. Teachers will show the brain and/or spinal cord regions through different 3D virtual anatomical models with LMC. It will allow students visualize and interact with the learning contents. LMC allows different images of the brain and the spinal cord with a great number of projections. After the online face-to-face lecture, students must use LMC for neuroanatomy learning, performing a number of virtual practices. At the end of the week, students will record a video demonstrating the learning of the proposed neuroanatomy contents using LMC. This recording must be delivered the first day of the second week. In addition, students will do an online exam where they must identify, in real time, using LMC any neuroanatomical structure studied in the current learning unit.

3. **Virtual Neurorehabilitation Teaching and Practicing Phase (Week 2):** In this phase students will learn to design a neurorehabilitation protocol for the pathology studied in phase 1. Students will be asked to combine conventional Physiotherapy (CP) and LMC. Initially, teachers will provide information about the main CP techniques for the management of neurological diseases. A study document will be sent to the students along with references where these techniques are used. This document will contain concepts about the benefits of passive and active mobilizations; specific methods like Proprioceptive Neuromuscular Facilitation (FNP), Bobath, Le Metayer, Brunnstrom; Voja and counsels to prevent complications. Then, the LMC will be presented as a therapeutic tool for clinical settings or home rehabilitation. Thus, students will be instructed to use LMC combined with CP. Theoretical contents about the use and benefits of VR in neurorrehabilitation will be explained to students. Teachers will show differents VR games to be used with LMC in clinical practice. Finally, students must carry out a simulated clinical case for the selected neurological pathology by using CP and LMC games. This simulation must be recorded in video showing how to use LMC and CP for patient's neurorehabilitation. A family member or a neurological patient living with them can participate in the simulation of the neurorehabilitation protocol. During this phase teachers must provide continuous feedback to students regarding their treatment proposal. The recorded simulation showing the proposed treatment will be used by teachers to evaluate the performance of students.

During the whole process of remote learning teachers will provide continuous feedback to students. Students will be also asked about the difficulties found during the learning process. Any feedback about technical problems and their solutions will be essential to improve teaching in further units. **Table 1** illustrates the course planning as well as the evaluation schedule.

At the end of the teaching-learning process of every learning unit, students will be individually evaluated about theoretical and practical learnings.

Objectives

This project is conceived to assess the feasibility of a remote learning course during COVID-19 home confinement addressed to the study of neuroanatomy and neuropathology by physiotherapy students. Students must: (1) be able to integrate theory and practice contents by using virtual anatomical models; (2) design an appropriate Physiotherapy neurorehabilitation protocol combining conventional procedures with VR tools using LMC; (3) get used with new VR-based tools, particularly LMC, for neurorehabilitation of sensorio-motor sequels in neurological diseases; (4) demonstrate how to use LMC as a neurorehabilitation tool based on active movement; (5) assess the acceptance of LMC-based virtual learning of neuroanatomy through the System Usability Scale; Finally (6) we will assess the effect of remote learning through LMC in self-regulated learning variables.

Required Resources

Figure 1 illustrates the necessary materials to carry out this project, including hardware, software and Internet connection. Regarding hardware, an LMC device is required. This device allows students to handle and interact with neuroanatomical images in order to carry out a significative learning. This device requires a laptop or desktop computer. After a previous survey it has been found that all students enrolled in the course have a computer and internet connection, so they will be able to work at home with this device. Currently we only have 15 LMC devices available, thanks to the collaboration with the University of Almería, which have been randomly sent to students. For the coming year we will require the University of Jaén to purchase 70 LMC devices under the premise that literature has shown that VR and LMC improve significative learning of Health Sciences concepts. To record the practice with LMC, the University of Jaen provides free access to Google's Gsuite Meet video platform.

Regarding software needs for Neuroanatomy and Neuropathology learning, we will use *Online Anatomical Human*, an open platform compatible with LMC that provides 2D and 3D anatomical information for educational purposes (Smit et al., 2016). According to Nainggolan et al. (2016), 3D neuroanatomy figures can be created using BodyParts3D, the Database Center for Life Science, Japan[1]. In addition, other apps related to neuroanatomy, such as *Cyber Science-Motion,* a free gaming software from Leap Motion App Store (Cyber Science Motion, 2020) may be used in this project as secondary software.

For the Virtual Neurorehabilitation Teaching and Practicing Phase we will choose games designed for LMC. Active video games are a task-oriented intervention which positively influence movement rehabilitation through increased practice of motor skills, and considered an interesting alternative treatment (Wuang et al., 2011; de Oliveira et al., 2016). The objectives of rehabilitation with LMC are to improve the joint range of motion, muscle strength, coordination, and fine motor functions of the hand and wrist in patients (Tarakci et al., 2019).

The games that the students will use in phase 2 are:

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TABLE 1 | Project stages.

		Week	
Phases	**Scheduled tasks**	**1**	**2**
1	Reception of theoretical content about neurological pathology and involved neuroanatomical area	X	
	G-Suite Meet face-to-face teaching sessions with LMC	X	
	Practical activities to learning neuroanatomy using LMC	X	
	Recorded video using LMC to learn neuroanatomy	X	
	Individualized online practical exam using LMC	X	
2	Teacher sends a document about the use of CP and LMC in neurorehabilitation of the neurological disease revised in the didactic unit		X
	Neurorehabilitation training with CP techniques		X
	Students are taught about the use of LMC in neurorehabilitation		X
	Development and recording of a neurorehabilitation protocol combining CP and LMC		X

Phase 1, Neuroanatomical and neuropathology teaching phase; 2, Virtual neurorehabilitation teaching and practicing phase; CP, Conventional physiotherapy; LMC, Leap motion controller.

FIGURE 1 | (A) Typical students' workplace including the leap motion controller. **(B)** Student using leap motion controller.

1. Free and accessible games for desktop PC from Leap Motion Gallery (Ultraleap Ltd, 2020):

   a. *Sculpting*: The aim of this LMC game is to sculpt different figures and forms using the hands. Patients with upper limb and hand disorders can use this game to improve its manual function.
   b. *Takt-Rhythm*: This LMC game goal is to play music in different spaces. Patients must touch different musical notes that appear in the screen, developing their manual skills and coordination.
   c. *V2 Playground*: In this LMC game users can grab and move robots in a virtual dance club. In addition, patients can stroke flower petals. This game, employed in a neurorehabilitation process, may allow patients develop their hand and fingers fine motor skills. In addition, the whole upper limb movement is necessary.
   d. *Joca-The Handglider*: In this game, the user must to control a plane with the movement of the hand and the elbow. The plane has to be driven in different spaces solving obstacles. This game is really interesting for a neurorehabilitation protocol due to development of the manual dexterity in ludic task.
   e. *Sortee:* This LMC game consist in selecting and throwing rubbish in different bins. Objects appear quickly and patients must to use their hands and fingers to sort it out. This game works the cognitive component along with manual dexterity.
   f. *Spider Escape 3D*: This LMC game requires a precise control of wrist, hand and fingers. Patients must use their upper limb to impulse a spider in order to obtain points. This game can be used in patients with less upper limb disorders, as it requires some precision.
   g. *PopPop!* The patient has to shoot a gun with a simple pinch of the fingers. It requires a high level of precision. This game is a good option to rehabilitate thumb and index finger movement.
   h. *Froggle:* In this LMC game users must guide a frog across lily pads solving obstacles and collecting positive scores. This game is useful to work coordination and manual dexterity with a cognitive component.

2. Other games used in movement rehabilitation studies are:

a. *Leapball:* is designed to focus on the development of grasping and single motor skills of the hand, to improve fingers dexterity and coordination, to improve hand flexion and extension abilities, to increase wrist and fingers joint range of motion, to improve movement speed, muscle strength, and motor control. In "Leapball" game, the user must grasp a virtual ball with all the fingers and to throw it into a bucket of the same color. The size of the ball can be reduced to provide progression to the ball (Tarakci et al., 2019).
b. *CatchAPet*: is aimed to hit the rabbits coming out of the holes with repetitive wrist flexion/extension movements. Rabbits come out randomly from the holes. The player sees the avatar of his/her hand on the screen and hits the rabbits coming out of the hole by doing consecutive wrist flexion/extension movements. The faster the rabbits are hit, more points are earned (Tarakci et al., 2019).

Feasibility and Viability of the Project

Around 75 students enroll every year in the course *"Specific Methods of Intervention in Physiotherapy III."* From those students interested in participating voluntarily in this project, 30 students will be randomly selected and divided into two groups. Fifteen students will be allocated to the LMC-based learning group and 15 to the classical online learning group. This initial project will serve as a pilot of a larger study that will take place when a larger number of LMCs are available (**Figure 2**). Two teachers will be in charge of the online teaching process and student's supervision, and will maintain a fluid communication with students through the use of G-Suite Meet tools, so they do not feel isolated during the learning process. Clinicians will also participate in every unit showing their practical experiences with patients and therapies. Materials requirements are more limited since at this time there are not LMC for not every student. The assignment of the devices should not extend longer than the course duration. We believe that this project is viable both in potential cases of future home confinement episodes or just to implement new online possibilities for neuroanatomy and neurology teaching.

INDICATORS OF STUDENTS PROGRESS AND ASSESSMENT OF SELF-REGULATED LEARNING VARIABLES

Teachers will assess the student's progress across every study unit through online theory and practice exams, and the assessment of two videos recorded by students. Regarding videoreports, one of them will demonstrate the use of LMC for neuroanatomy learning. The second videoreport will illustrate how to develop a neurorehabilitation protocol combining CP and LMC in a clinical case simulation. Regarding the two online test, a practical exam using LMC to identify neuroanatomical structures will be carried out. The other exam will assess theoretical contents corresponding to every study unit. A weighted average mark will be calculated from all study unit score. **Table 2** shows the rubric with the proposed scoring for each phase activities.

First, the usability or management of the LMC as teaching device will be assessed. The Spanish Version of the System Usability Scale (sv-SUS) for the assessment of Electronic Tools will be used. The sv-SUS is a tool used to assess the usability of a system, and was initially developed in English (Brooke, 1996). It is a self-administered questionnaire of 10 Likert-type questions with 5 response options, from 1 (strongly disagree) to 5 (strongly agree) and higher scores mean a greater usability of the system (Brooke, 2013). The sv-SUS is easy to understand, has shown a high internal reliability (Cronbach α-value of 0.812), and a face validity index of 0.94 (Sevilla-Gonzalez et al., 2020).

In this project, different LMC videogames will be used. So, the experience of physiotherapy students using these videogames will be assessed with the Spanish version of the Gameful Experience (GAMEX) (Parra-González and Segura-Robles, 2019). GAMEX is Likert scale ranging from 1 (never) to 5 (always) for 27 items distributed into six different domains: enjoyment, absorption, creative thinking, activation, absence of negative effects and dominance (Eppmann et al., 2018). This scale has shown a high reliability with a Cronbach α-value of 0.855. The Cronbach α for different dimensions are 0.843 for enjoyment, 0.898 for absorption, 0.865 for creative thinking, 0.790 for activation, 0.841 for absence of negative effects and 0.860 for dominance (Márquez-Hernández et al., 2019).

Students' satisfaction as a measure of teaching quality will be studied with the Spanish version of Student Evaluation of Educational Quality (SEEQ)-Short version questionnaire (Bol Arreba et al., 2013). This is a five points Likert-type scale with 10 items that analyzes: Students' interest in the subject, the use of teaching materials, teachers' interest in the subject, teachers' accessibility during tutoring time and outside class hours, the usefulness of teaching materials, the continuous assessment process and its usefulness, the adjustment of the evaluation procedures, the quality and clarity of teaching materials, teachers' capability of motivation for increasing students' participation in the class and the workload of the subject (Marsh, 1987). The Spanish version of SEEQ-Short version has shown a high reliability with a Cronbach's α coefficient of 0.92 and significant correlations among all its domains (Bol Arreba et al., 2013).

The student's perception of the online learning environment will be analyzed as a measure of teaching quality at the end of the project by using the Spanish version of the Distance Education Learning Environments Survey (sp-DELES) (Fernández-Pascual et al., 2015). This instrument includes seven scales: instructor support, student interaction and collaboration, personal relevance, authentic learning, active learning, autonomy and student's satisfaction (Walker and Fraser, 2005). The sp-DELES has shown a good reliability (Cronbach's α coefficient between 0.86 and 0.97) and the original structure of six factors has been replicated and accounts for 72.9% of the total variance (Fernández-Pascual et al., 2015).

Besides, self-regulated learning strategies in participant students will be evaluated with the CEVEAPEU questionnaire (Gargallo et al., 2009). It is an 88-item five points Likert-type scale developed for assessing learning strategies in university

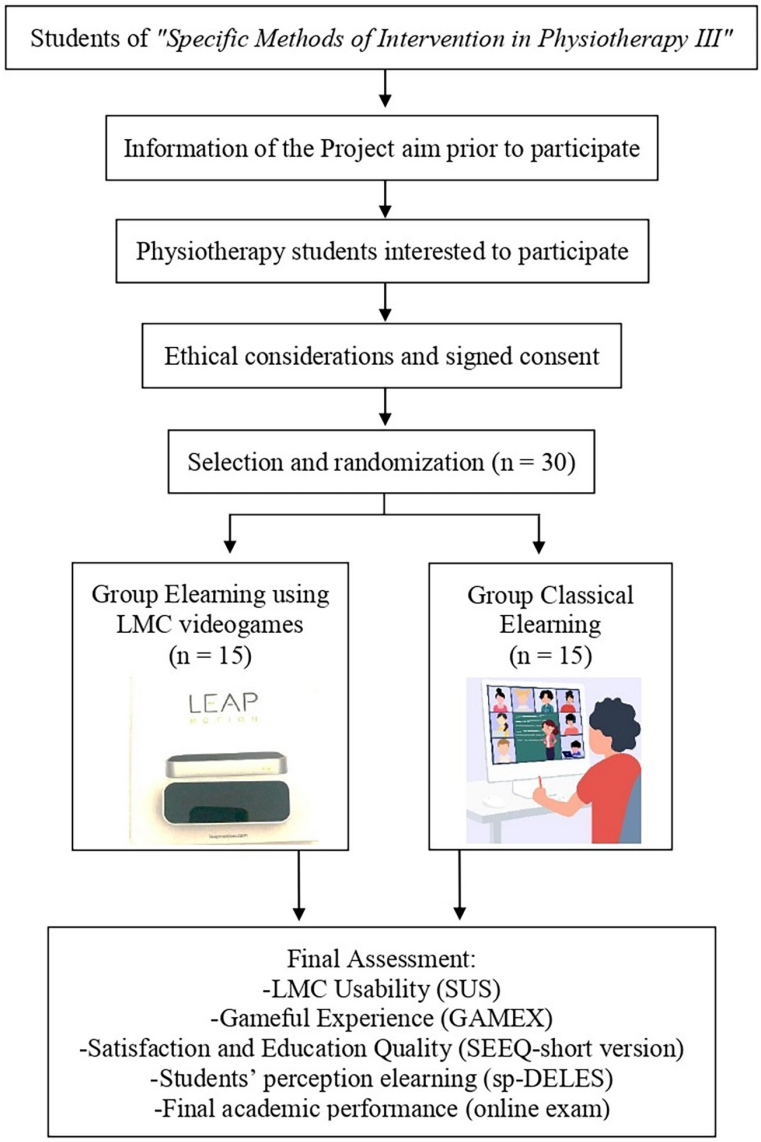

FIGURE 2 | Flow diagram.

students consisting of two scales. The first scale is related to Affective, Support and Control Strategies and includes subscales about Motivational Strategies, Affective Components, Metacognitive Strategies, Control of Context, Social Interaction and Resources Management Strategies. The second part of CEVEAPEU assesses Information Processing Strategies. It includes two subscales related to Information Search and Selection Strategies, and Strategies of Information Processing and Use. The CEVEAPEU questionnaire has shown a high reliability (Cronbach's α coefficient of 0.897; Gargallo et al., 2009).

Finally, students' academic performance will be evaluated in both groups through an test with 30 items.

For the analysis and treatment of data, the statistical package IBM SPSS Version 20.0 will be used (SPSS, 2020).

EXPECTED RESULTS

We pretend to remark the importance of introducing virtual learning strategies to get a successful training during the home confinement period, when students with low motivation or bad study habits may fail in the learning process. We consider that the use of VR tools will reduce such disadvantages, and students involved in the project will develop significative learning of the topics studied, as well as practical and professional abilities. Thus, it is feasible that students included in this methodology will obtain better marks than students following traditional or E-Learning methodologies as result of an increase of their motivation and development of self-regulated learning strategies. Moreover, students will also be able to identify new potential uses for VR tools in neurorehabilitation, as well as

TABLE 2 | Evaluation rubric for theorical and practical contents.

Neuroanatomy recorded video using LMC (Maximun 2 points)	Neurorehabilitation recorded video using LMC (Maximun 3 points)	Individualized and practical test online using LMC (Maximun 1 point)	Individualized theoretical online test of the end of didactid unit (Maximun 4 points)
Student makes the recording fluently describing the main anatomical regions proposed in the theoretical content: **1 point**	Student show a complete knowledge about the studied pathology, necessary to the correct functional and neurological Physiotherapy's diagnos: **0.5 points**	Answer correctly 50% of the questions: **0.5 points**	Answer correctly 50% of the questions: **2 points**
Student is able to expand the didactic content by locating structures not corresponding to said thematic unit: **1 point**	Students identifies correctly the main motor disorders in the proposed clinical case: **1 point**	Answer correctly 75% of the questions: **0.75 points**	Answer correctly 75% of the questions: **3 points**
	Student establishes an appropriate protocol using CP techniques and LMC: **1 point**	Answer correctly all questions: **1 point**	Answer correctly all questions: **4 points**
	The LMC games proposed are adequate to the characteristics of the patient: **0.5 points**		

The delay in the delivery of the recorded videos will suppose a penalty of 10% proportional in the qualification. It is necessary to answer correctly 50% of online test questions to pass this didadic unit.

to propose new physiotherapy treatments that combine classic neurorehabilitation and VR therapy.

A previous work by Stephan et al. (2017) reported that students were highly motivated and showed higher participation and understanding of lectures through the use of virtual environments compared to blended learning methodology. Nevertheless, they informed that students reported some difficulties using VR tools. We expect these difficulties will be overcome by initial training on the use of LMC and the initial feedback received from students that will be used to improve subsequent activities. A recent work by Harfouche and Nakhle (2020) have shown that VR can be implemented in distance learning as a useful tool to motivate students, encouraging interactive learning, developing critical thinking and decision-making skills. Nevertheless, to our knowledge, there are not studies that assess how VR solutions affect specific learning strategies, and potentially improve those strategies necessary for a successful self-regulated learning. We will assess how the introduction of VR affects these variables through a validated questionnaire (CEVEAPEU).

By the end of this project it is expected an increase of students' motivational strategies, particularly intrinsic motivation, higher task value and self-efficacy perception. These variables are particularly relevant for self-regulated learning (López Paz et al., 2018) and will be linked with an improvement of information search and selection strategies as students must actively search information in databases and apply it to the course tasks. We expect that it will positively affect information processing and use, including information acquisition, development, and planning, critical thinking and memorization. Metacognitive strategies are also expected to improve, with an enhancement of control and self-regulation, linked to knowledge of learning goals and evaluation criteria which are explicit from the beginning of the course. This will positively affect learning planification and self-assessment. Finally, it is expected an increase of information transference and use of learnings as students can find a high applicability of virtual simulations in professional contexts.

In self-regulated learning strategies also must consider emotional variables. We expect an improvement of affective components, with a reduction of anxiety that would be associated to the perception of social support in the learning process during confinement by teachers and other students.

Regarding the opinion of students about teaching quality, we expect positive results in the assessment with the SEEQ-short form and sp-DELES questionnaire. In this sense, the continuous assessment process and feedback proposed by this project will result in an improvement of teaching quality during home confinement.

When home confinement period ends this project can still be used in our course, reinforcing face-to-face classroom work at home. It would be ideal that students can loan LMC devices to be used in other courses of Physiotherapy studies. It will require we also train our colleagues. With this goal, the promotors of this project will offer informative sessions and seminaries about the use of LCM and the other VR devices susceptible to be used as a teaching tool. We expect our results encourage teachers of Physiotherapy Studies to use virtual teaching in the future, both in case of a new confinement episode or just as a e-learning valuable tool.

PROJECT CONSTRAINTS

To promote the use of LMC during home confinement and later as useful virtual teaching tool, we must overcome logistics and financial barriers. In this sense, LMC has a competitive price and it just requires a computer, specific anatomical 3D software and Internet connection. Not all students have the same possibilities of accessing technology or Internet connection, so universities should make an effort to provide them the necessary resources to study at home during confinement and get advantage of LCM attributes for neuroanatomy teaching. As an initial measure, the University of Jaen provides support to low income students free Internet connection. If the home confinement were extended over time during the beginning of the next academic year, the

University would have all the necessary materials so new students will not have difficulties to participate in the e-learning project.

CONCLUSION

LMC postulates as an inexpensive VR device useful in the teaching-learning process of neuroanatomy and neurorehabilitation topics for Health Sciences studies, particularly in Physiotherapy degrees. Besides, VR technology has already shown satisfactory results and higher levels of interaction than 2D and 3D images and videos. The combination of VR and digital imagery together with the analysis of clinical cases will become a good learning strategy that will increase students' motivation and adherence to virtual e-learning during home confinement. However, according with recent studies, it will be also essential to promote an active lifestyle during home leaning aimed to reduce the negative emotional consequences of social distancing and increase mental health to improve academic performance during home confinement. In addition, teachers' commitment will play a fundamental role to accompany the student in the acquisition of the objectives proposed in the project. This project shows the flexibility of Physiotherapy teachers at the University of Jaén to adapt to the changes motivated by COVID-19.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

EO-G, FN-E, NZ-A, and IC-P conceived and developed this project. EO-G, NZ-A, and IC-P wrote the manuscript. FN-E revised and verified the final version. All authors have read and accepted the content of the manuscript.

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Analysis of Psychosocial Adjustment in the Family During Confinement: Problems and Habits of Children and Youth and Parental Stress and Resilience

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The COVID-19 health crisis has led to a dramatic change in dynamics and habits of families, which may be a factor involved in the development and maintenance of problems and difficulties in children. The present study is a cross-sectional study that aims to describe and analyze the relationship between the difficulties in psychological adjustment and the change of habits of the infant-juvenile population as perceived by their parents and their stress and resilience during the total confinement of the first wave of the COVID-19 pandemic in Spain, as well as analyzing the course of the changes and the relationships between weeks 3 to 6, that is, the score of different participants in each week of the confinement. The sample is comprised of 883 parents of children and adolescents between 3 and 18 years of age. Children's psychological adjustment, children's habits, parental stress, and parental resilience were assessed by parents. The results show that parents perceive a change in the habits and psychological difficulties in their children. At the same time, our results describe parents with a high level of stress and resilience, with differences depending on the children's ages. The time of confinement accentuates the perception of parents about the psychological difficulties of their children and parental stress, as well as a decrease in resilience. These difficulties are reduced when the parent has resilience competencies. These results show that the resilience of parents mediate the relationship between parental stress and psychological problems of their children. These results shows that COVID-19 lockdown had a considerable effect on families, both on children and parents. Some practical implications based on results are provided.

Keywords: adolescence, COVID-19, children, habits, parents, parental stress, parental resilience, lockdown

INTRODUCTION

In order to contain and mitigate COVID-19, countries have adopted different health, social and education measures (Imai et al., 2020). Among others, home confinement and school closures have affected 86% of the children around the world, propitiating changes in general social functioning and increased inequality (The Lancet Child Adolescent Health, 2020). The need to maintain

epidemiological control of the pandemic has entailed a drastic change in the lives of citizens in all the areas of life, from work to home, altering daily practices and family habits. However, what from the strictly healthcare viewpoint seems an ineludible demand, can have implications for children which cannot be ignored. It is important to maintain certain habits, especially in childhood and adolescence, because of the cognitive repercussions (Maureira Cid and Flores Ferro, 2017; Pisch et al., 2019), on acquisition of behavior patterns and social knowledge, children's health and social and economic benefits to their development and that of future generations (World Health Organization [WHO], 2020). It is easily surmised that such government measures have affected the routines of both adults (Liu N. et al., 2020; Sun et al., 2020) and children (Berasategui Sancho et al., 2020; Orgilés et al., 2020), although the significance of the change in routines and the psychological impact that this could have on parents and children is hard to define. As already demonstrated, it is influenced by its duration, and other factors, such as fear, inadequate information or modification in the daily lives of children (Brooks et al., 2020; Gómez-Becerra et al., 2020; Sandín et al., 2020). The significance of changes in habits of small children after traumatic events was described by Echeburúa et al. (2004) as the more problematic expression of sorrow, exteriorized by a loss of learning and acquired habits, withdrawal, fear, unexpected reactions, accentuation of preexisting traits (nervousness or sadness) as well as separation anxiety. Thus, sleep problems have been shown to be predictors of separation anxiety (Orgilés et al., 2016), which is especially important considering the vulnerability of children who have been separated from their caregivers during the pandemic (Liu J. J. et al., 2020). Studies focused on the effects of continual exposure to violence or terrorism, have observed that short-term changes produce long-term collective habituation in children and adults, as well as development of strengths (hope, optimism, gratitude, spirituality or altruism, curiosity, among others) in both individuals and groups (Vázquez et al., 2008).

According to the classic definition of stress (Folkman and Lazarus, 1985; Lazarus and Folkman, 1986) as a phenomenon that appears when a situation overwhelms personal resources and coping strategies are insufficient or inadequate, the current situation seems to meet all the requirements for the appearance of such a response in parents. School closures have been an added burden for parents who must take on the school routines of their children along with other demands and concerns (emotional, hygiene, work, economic, etc.) the pandemic has brought on. This work overload of the main caregiver has been related to parental stress Vela Llauradó and Suárez Riveiro, 2020), and in turn, with competencies and attitudes in the role of parent (Pérez Padilla et al., 2010).

In the family context, birth of children and bringing them up, which leads to personal restructuring, assuming responsibilities or discrepancy between expectations for parenting and its real demands, have been considered potentially stressful events, which has led to giving parental stress a definition with its own entity (Cameron et al., 1991; Berry and Jones, 1995). Although it has conceptual differences from other forms of stress, it shows close association with them (Holly et al., 2019). Deater-Deckard (2004) defined parental stress as "a set of processes that lead to adverse psychological and physiological reactions derived from the attempts of adapting to the demands of parenting. This is often experienced as negative feelings or beliefs about oneself and the child" (p.6), to which environmental and social circumstances should be added (Cronin and Becher, 2015).

However, not all families experience the same amount of stress, as their approach to parenting may differ, and personal characteristics of both adults and children, family climate and socioeconomic setting of the family nucleus (see Hayes and Watson, 2013 for a review) all strongly influence the demands on parents (Oronoz et al., 2007), their perception of their competence and self-efficacy as parents (Raikes and Thompson, 2005; Díaz-Herrero et al., 2010), as well as paternal, family (Ispa et al., 2004; Putnick et al., 2008; Estes et al., 2009; Farmer and Lee, 2011) and children's characteristics (Byrne and Cunningham, 1985; Anastopoulos et al., 1992; Crnic and Low, 2002; Gupta, 2007; Tripp et al., 2007; Wang et al., 2011; Mount and Dillon, 2014; Kim, 2017; Rajan and John, 2017).

Studies analyzing social factors that could be determinant in parenting, have found that parental stress is more prevalent in families in a vulnerable situation (Ceballo and McLoyd, 2002; Chaudry and Wimer, 2016). Factors commonly associated with this vulnerability are low parent education (Raikes and Thompson, 2005), single parenting (Olhaberry and Farkas, 2012), economic problems, unemployment and low-qualification jobs (Duncan and Brooks-Gunn, 2000; Ayala-Nunes et al., 2014). These also seem to be facilitators not only of parental stress, but of low self-perception of competence as parents (Raikes and Thompson, 2005; Morrison et al., 2014).

One psychological phenomenon frequently studied with regard to stress is resilience, whether understood as an individual trait or personality attribute, as a result of the person's behavior, or as a dynamic process (García del Castillo et al., 2016), enabling a healthy response to adversity or possible stressors (Ortega, 2014). Theoretical-practical interest in this construct has not stopped growing since the first studies in the last decades of the 20th century (Villalba Quesada, 2003; Becoña, 2006; Wagnild, 2009; Pinto-Cortez, 2014; Fernandes de Araújo et al., 2015; García del Castillo et al., 2016; Ramón Fernández et al., 2019).

Studies defining the relationship between resilience and other variables have demonstrated its buffering effect in people exposed to adverse situations, such as adults exposed to armed conflict in Colombia (Hewitt Ramírez et al., 2016), who have to struggle with stress, anxiety and/or depression (Bitsika et al., 2013). In fact, the positive correlation between resilience and psychological wellbeing, activities promoting health, sense of life, coherence, morality and age has been underlined. In comparison, there is a negative correlation between resilience and stress, anxiety and/or depression (Wagnild, 2009; Sánchez-Teruel and Robles-Bello, 2015). Along this line, Fernandes de Araújo et al. (2015) emphasized the role of resilience in the family as a protective factor and mediator in coping with negative circumstances, stressing the association between high levels of resilience and little presence or manifestation of psychological disorders.

In our review of the literature, we already found studies evaluating resilience in coping with the COVID-19 crisis (Giallonardo et al., 2020; Lozano-Díaz et al., 2020; among others). However, it has become necessary to go more deeply into resilience as it relates to stress, and specifically, parental stress, in view of the exceptional circumstances experienced by families as a consequence of the lockdown and social distancing imposed to contain the disease.

The relationship between parental stress and resilience has been widely documented in families with children who have neurodevelopmental disorders, and in such families, parents usually have more stress and less resilience than those with children with no disorder (Cara García, 2019). In that line, it has been observed that the parents of children with Autistic Spectrum Disorder (ASD) have scored significantly lower in resilience than parents of children with normal/typical development (Tijeras Iborra, 2017). In a study with a sample of 299 families with children with and without disability, Vela Llauradó and Suárez Riveiro (2020) defined the relationship between parental stress and resilience as significant and negative, and considered the latter as a protective factor against stress. Supporting this relationship, Suzuki et al. (2018) stated that family resilience reduces maternal stress, in as much as the capacity for resilience in the family influences individual resilience.

The present cross-sectional study described and analyzed the relationship between the difficulties in psychological adjustment and changes in habits of the infant-juvenile population as perceived by their parents, and parental stress and resilience during total confinement due to the first wave of the COVID-19 pandemic in Spain. It also analyzed family response by the week of confinement when they filled in the questionnaire, from weeks three to six. The following specific objectives were pursued:

(1) Describe the variables studied (children's problems and changes in habits, as well as parental stress and resilience) both in the total sample and by children's age/grade level and by week of confinement.
(2) Find out whether there were significant differences in the parents' perception of their children's psychological problems and changes in their habits, as well as self-perceived stress and resilience, by children's ages and/or week of confinement.
(3) Explore the relationship between perceived children's psychological problems and changes in habits and parental factors (stress and resilience).
(4) Assess the influence of parents' perceived changes in their children's habits on both perceived children's psychological problems and parental factors (stress and resilience).
(5) Examine the role of resilience between parents' self-perceived stress and their perception of their children's psychological problems.

In light of the information reviewed, the following hypotheses were proposed:

Hypothesis 1: The psychological adjustment of parents, children and adolescents will be low, that is, problems will be perceived in children and parental stress will be above the mean.

Hypothesis 2: Children's psychological adjustment problems will increase with time of confinement. Families that have been confined fewer weeks will perceive fewer children's psychological problems than families that have been confined longer.

Hypothesis 3: There will be significant differences in children's adjustment and habits, and parental stress and resilience by week of confinement and age group.

Hypothesis 4: Parents with higher stress will perceive more psychological difficulties in their children.

Hypothesis 5: Parents who perceive themselves to be more resilient will be less stressed.

Hypothesis 6: Parents who perceive changes in their children's habits will report that their children have more psychological problems and will themselves have higher levels of stress.

Hypothesis 7: Resilience will mediate between parental stress and children's perception of psychological difficulties.

MATERIALS AND METHODS

Participants

The reference population for this study was made up of parents with children aged 3 to 18. Exclusion criteria were a child's clinical diagnosis of disability, psychological disorder or severe illness. With this target population, the original sample surveyed was 1078 families. When the incomplete or invalid surveys had been eliminated, the final sample was 883 parents aged 25 to 69 (M = 40.46; SD = 6.16). Mostly mothers answered (93.9%), almost all were Spanish (95.6%), and most had a high school or university education (74.4%). The sample was mostly employed in services (45.2%) or in education, culture and health (37.7%). These data distributed by age of their children is shown in **Table 1**. 81.8% of the participants said there were two parents in the family. The most frequent employment situations of the sample during lockdown were working online due to COVID-19 (32%) and dismissal due to the crisis generated by the pandemic (20.2%) and two conditions that did not undergo change as a consequence of the crisis, unemployed before and now (13.8%) and going to work before and now (13.8%).

Most of the families (53.1%) had two children, 36.1% had one child, and 9.7% had three children, and only 1% had four or more children. Considering the total number of children in the sample (n = 1555), the majority of children are female (53.18%; n = 827) compared to 46.81% (n = 728) who are male. The ages of children were distributed as illustrated in **Table 1**.

Study Type and Design

The study was a cross-sectional description of populations, conducted by means of a survey with probabilistic samples to

TABLE 1 | Sociodemographic data of sample (*N* = 883).

Children's Age range/ Edutation levels	% of mothers	Age of parents. M(SD)	% of Spanish	% of Biparental families structure	% of secondary studies or more (parents)
Toddlers - less than 3 years(*n* = 65)	98.5	35.74 (4.11)	100	90.8	78.5
Toddlers - 3 to 5 years(*n* = 283)	94.7	36.8 (4.51)	94	89	76.3
Basic education (6 to 11 years)(*n* = 353)	95.8	40.84 (4.95)	95.4	78.9	72.8
High school (12 to16 years)(*n* = 122)	90.2	45.68 (4.8)	96.7	73	68
High school (more than 16 years)(*n* = 60)	81.7	50.43 (3.86)	96.7	73.3	83.3

acquire empirical evidence using a quantitative methodology (Montero and León, 2007).

The study started in the third week of confinement until the sixth week, when the children were allowed to leave home again; therefore, data collection lasted 4 weeks. The study, even with a cross-sectional methodology, allowed us to evaluate the weekly changes throughout the confinement by making comparisons between the questionnaires collected over the weeks. At the same time, in all cases the context of data collection was online with a non-probabilistic "snowball" sampling strategy.

Instruments and Variables

The variables selected for this study analyzed in families through a battery of online questionnaires, were the following:

Sociodemographic variables of the parents, measured using questions prepared for the purpose at the start of the survey.

General psychological state of children and adolescents with the Spanish version of the *Strengths and Difficulties Questionnaire* (SDQ; Goodman, 1997). This instrument is a dimensional measure of mental health and screening for emotional and behavior problems. The questionnaire is applied to parents, teachers and/or adolescents. It is comprised of 25 items rated on a three-point Likert-type scale and distributed in five subscales: emotional symptoms, behavior problems, hyperactivity, peer relations problems and prosocial behavior. Its psychometric properties are internal consistency of $\alpha = 0.79$. This study used the reported version for parents, which has an internal consistency of.58 to.80 (Español-Martín et al., 2020). The scales established were followed with cutoff points at the 80th percentile for subclinical and 90th for clinical ranges, except for the prosocial behavior subscale, which is at the 10th and 20th percentile, respectively (Español-Martín et al., 2020). Internal consistency in this study was a Cronbach's alpha of.74 for the total score. For the subscales, the Cronbach's alpha was.54 for the emotional symptoms scale, 0.59 for behavior problems, 0.76 for the hyperactivity scale, 0.57 for problems with peers and.38 for prosocial behavior.

A self-report designed for the purpose on *habits of everyday living* and possible changes that may have occurred in them during lockdown, comprised of seven items with a five-point Likert scale (1 = not at all to 5 = very much), which evaluate sleep routines, eating patterns, hygiene habits, interpersonal relations with friends and family, emotional state, and fear, with an internal consistency of $\alpha = 0.67$ (**Appendix 1** shows the specific items of the self-report).

The level of parental stress was evaluated using the Spanish version (Oronoz et al., 2007) of the *Parental Stress Scale* (PSS) by Berry and Jones (1995) is composed of 12 items on a 5-point Likert scale and assesses stress in two sub-scales: (1) child rewards, which refers to satisfaction as a parent in your parental role; and (2) stressors, which refers to the level of stress related to parenting. A higher score means a higher level of stress, the mean score in the total test is for women 22.3 and for men 20, in direct scores; and for the sub-scales the means are: in reinforcers for women 6.9 and for men 7.1; while for stressors the mean for women is 15 and for men 13. The internal consistency of the scale is a Cronbach's alpha of.77 for the rewards subscale and.76 for the stressors subscale.

Parental capacity for resilience was measured with the Spanish version of the 14-item *Resilience Scale (ER-14)* by Wagnild (2009). It considers resilience a positive personality characteristic which enables individual adaptation to adverse situations. The RS-14 measures two factors: (1) Personal competence which is composed of 11 items assessing self-confidence, independence, decisiveness, resourcefulness, and perseverance, and (2) the self-acceptance scale, which is composed of three items assessing adaptability, balance, flexibility, and a stable life perspective. The responses are scored on a Likert scale from 1 to 7. The mean scale score is 71 (SD = 32.81). For the subscales it is 56 (SD = 19.29) and 15.08 (SD = 7.84), respectively. The version of the scale by Sánchez-Teruel and Robles-Bello (2015) shows adequate internal consistency ($\alpha = 0.79$) and validity of criteria calculated with other measures of general resilience (CD-RISC) ($r = 0.87$; $p < 0.01$).

Procedure

First, the survey or battery was designed. Tests for this had previously been selected according to their contents on the variables of interest and psychometric properties. These were transferred to an online evaluation protocol using *LimeSurvey*®.

After requesting the authors' university bioethics committee for the pertinent authorizations, the test was published in three ways: (1) An incidental sample through social networks. (2) A convenience sample acquired with distribution focused on various professions that work with families. (3) Interprofessional relationships in the sectors mentioned in the second group above, who were contacted by email.

Furthermore, it should be noted that the socio-educational context at the time of the study in Spain was characterized by total confinement, in which children and adolescents could not attend school, go out to the parks, go to the streets, or participate

in their usual leisure activities. They could not visit other family members or friends. Their parents, in turn, could be teleworking or unemployed. In many families there could be sick, isolated or even hospitalized family members. All of these restrictions were drastic, and were not clearly established from the outset, but were updated weekly, so there was a degree of uncertainty regarding when the restrictions would end.

Finally, the participants answered after reading all ethical aspects and guarantees and giving their informed consent.

Data Analysis

First, a descriptive analysis of the variables (mean and standard deviation) was done for the total sample and by age and grade level (under 3 years (1st cycle toddlers), from 3 to 5 (2nd cycle toddlers), from 6 to 11 (basic education), from 12 to 15 (high school) and 16 to 18 (high school). Differences between age groups were evaluated by one-factor ANOVA. Differences between participants who completed the assessment from the third to sixth week were studied, with a one-factor ANOVA in which the week of response was the comparison factor between variables analyzed. Furthermore, to examine the effects of time of confinement based on age range, a MANOVA was done in which the time*age interaction was considered. The effect size for the analysis of variance was performed using etha-square. *Post hoc* comparisons were performed, and the effect size was estimated using Cohens' d. Relationships between variables analyzed were explored with a Pearson correlation analysis.

The differences in parenting variables (stress and resilience) and children's problems were evaluated by perception of change in habits during lockdown. The Student's *t* for independent samples was used to compare the parents' mean scores. A score below 3 indicated little change in habits, while a score over 3 showed sizeable or significant change. The effect size for was determined by using the Cohens' d.

A multiple regression analysis was done, in which the total difficulties score (SDQ) as the dependent variable and changes in children's habits as the independent variable, to find out which variables explained the variance in change in children's habits. Finally, a mediation analysis was done of parental stress and the variables of difficulties evaluated with the SDQ, in which own personal resilience and acceptance of oneself were considered mediators. The analyses were done using SPSS 21. The mediation analysis was done with the R program.

RESULTS

Descriptive Analysis and Role of Age/Educational Level and/or Week of Confinement

Table 2 shows the mean scores and standard deviations of the variables. The mean scores on the SDQ were within the limits for emotional symptoms, behavior problems, hyperactivity/inattention, prosocial behavior and total SDQ difficulties score. The average parental stress scores were above the normative mean of the evaluation instrument. The resilience scores were above the mean on the personal competence scales and the total for the instrument, although the mean score on acceptance of oneself on resilience was below the mean. The mean score in changes in habits was 17.8 (SD = 4.53) which is 6.11 points above the mean between the instrument maximum and minimum.

Statistically significant scores were found by age (divided into grade levels) in total SDQ difficulties, emotional symptoms, behavior problems, hyperactivity symptoms and prosocial behavior. Statistically significant differences were found for parents in stress, stressors, resilience, personal competence and acceptance of oneself. Statistically significant differences were found in habits between age ranges (**Table 2**). In addition, it may be observed how family members reported the difficulty in contact with peers (M = 3.25; SD = 1.12), sleep problems (M = 2.86; SD = 1.21) and contact with family members (M = 2.8; SD = 1.07) were the most frequent changes in their children's habits (**Figure 1**).

In relation to the differences between age groups, in the *post hoc* analysis we found statistically significant differences in the total score of difficulties (SDQ) between children under 3 years of age with children between 12 and 16 (t = 4.465; $p < 0.001$; d = 0.7) and with children older than 16 years (t = 4.948; $p < 0.001$; d = 1). On the other hand, we found these differences between the scores of children between 3 and 6 years old with children between 12 and 16 (t = 4.355; $p < 0.001$; d = 0.45) and with children older than 16 (t = 4.554; $p < 0.001$; d = 0.68). As well as, statistically significant differences were found among children between 6 and 11 years of age with children between 12 and 16 (t = 3.799; $p < 0.005$; d = 0.38) and with children older than 16 (t = 4-115; $p < 0.001$; d = 0.56). Significant differences were found in the score of the behavioral problems scale between children aged older than 16 years compared to children under 3 years (t = 4.539; $p < 0.001$; d = 0.84), children between 3 and 6 years (t = 4.673; $p < 0.001$; d = 0.66) and children between 7 and 11 years (t = 3.837; $p < 0.001$; d = 0.55). In the hyperactivity problems scale, differences were found between children under three years of age compared to the ranges of 6 to 11 years (t = 3.883; $p < 0.001$; d = 0.5), 12 to 16 years (t = 6.719; $p < 0.001$; d = 1.09) and older than 16 years (t = 7.004; $p < 0.001$; d = 1.308). There were differences between children between 3 and 6 years of age with 6 to 11 years (t = 3.467; $p < 0.01$; d = 0.27), 12 to 16 years (t = 7.242; $p < 0.001$; d = 0.81) and older than 16 years (t = 7.082; $p < 0.001$; d = 1.034). In this scale, differences are found between children between 6 and 11 years old with children from 12 to 16 years old (t = 4.834; $p < 0.001$; d = 0.46) and older than 16 years old (t = 5.227; $p < 0.001$; d = 7). No significant differences were found in the rest of the *post hoc* comparisons of the SDQ scales.

Regarding parental stress, differences were found between parents of children under 3 years of age compared to parents of children over 16 years of age (t = 4.64; $p < 0.001$; d = 0.87). Likewise, differences were found between parents of children between 3 and 6 years of age compared to parents of children over 16 years of age (t = 3.419; $p < 0.001$; d = 0.48). Differences are found between parents of children between 7 and 11 years old

TABLE 2 | Mean scores and standard deviation of variables for the total sample (*N* = 883), by school levels and differences in means by age ranges.

	Total simple (*n* = 883)		Years (scholar level)										ANOVA		
			Toddlers - less than 3 years (*n* = 65)		Toddlers - 3 to 5 years (*n* = 283)		Basic education (6 to 11 years) (*n* = 353)		High school (12 to16 years)		High school (more than 16 years)				
	M	*DT*	*M*	*DT*	*M*	*DT*	*M*	*DT*	*M*	*DT*	*M*	*DT*	*F*	*p*	n^2
SDQ	13.00	5.47	14.92	4.68	13.65	5.14	13.26	5.59	11.12	5.71	10.18	4.81	11.25	0.000	0.049
Emotional Sx.	3.69	1.81	3.82	2.04	3.56	1.70	3.91	1.83	3.39	1.88	3.50	1.74	2.69	0.03	0.012
Behavioral Px.	2.40	1.66	2.88	1.73	2.61	1.63	2.42	1.62	1.97	1.72	1.55	1.38	8.796	0.000	0.039
Hyperactivity	5.21	2.53	6.45	2.33	5.85	2.35	5.19	2.53	3.97	2.23	3.43	2.28	25.72	0.000	0.105
Peer Px.	1.71	1.65	1.78	1.47	1.62	1.52	1.74	1.78	1.80	1.74	1.70	1.49	0.343	0.849	0.002
Pro social	6.15	1.67	5.74	1.75	6.05	1.64	6.40	1.69	5.98	1.61	5.88	1.54	4.016	0.003	0.018
Routines	17.78	4.53	19.20	4.67	18.08	4.41	17.72	4.51	17.32	4.54	16.17	4.57	4.206	0.002	0.019
PSS	25.96	7.91	28.89	6.56	26.20	7.67	26.31	7.66	24.57	8.95	22.40	8.20	6.598	0.000	0.029
Stressors	18.83	6.57	21.72	5.48	19.16	6.24	19.21	6.48	17.21	7.08	15.25	6.70	10.33	0.000	0.045
Rewards	7.12	2.75	7.17	2.34	7.04	2.59	7.10	2.77	7.36	3.32	7.15	2.52	0.306	0.874	0.001
R-14	75.11	11.73	70.28	12.68	74.39	11.91	75.36	11.51	77.44	11.38	77.50	10.19	4.983	0.001	0.022
Competence	60.62	9.20	57.28	9.48	60.08	9.40	60.87	9.12	62.14	8.79	62.25	8.27	3.801	0.005	0.017
Acceptance	14.48	3.20	13.00	3.72	14.30	3.21	14.49	3.06	15.30	3.14	15.25	2.85	6.766	0.000	0.03

Sx.: symptoms; Px.: problems.

compared to parents of children older than 16 years old ($t = 3.579$; $p < 0.001$; $d = 0.5$).

In relation to parental resilience, differences were found between parents of children under 3 years old compared to parents of children between 12 and 16 years old ($t = 4.013$; $p < 0.001$; $d = 62$) and parents of children over 16 years old ($t = 3.469$; $p < 0.001$; $d = 0.62$).

In order to check for changes in parents' perceptions between weeks of confinement an ANOVA analysis is performed. **Table 3** shows that there were statistically significant differences in the scores reported by the parents in the different weeks during lockdown in all the variables except for prosocial behavior and rewards of parenting. As the weeks of lockdown went on, higher scores were observed on the SDQ scales, that is, more perception of children's problems and difficulties. In problems with peers, variability was observed between weeks and prosocial behavior remained stable. For the hyperactivity or inattention score and SDQ overall score the effect size is moderate (see **Table 3** for effect sizes). Changes in habits increased as the weeks of lockdown went on, with a moderate effect size. Regarding, the instruments referring to the parents showed a certain homogeneity in the rewards of parenting scores over the weeks and instability in stress, although the scores in the last week were higher than in the first. Resilience was observed to decrease over the weeks, dropping more noticeably in acceptance of oneself. For these variables a small effect size is observed.

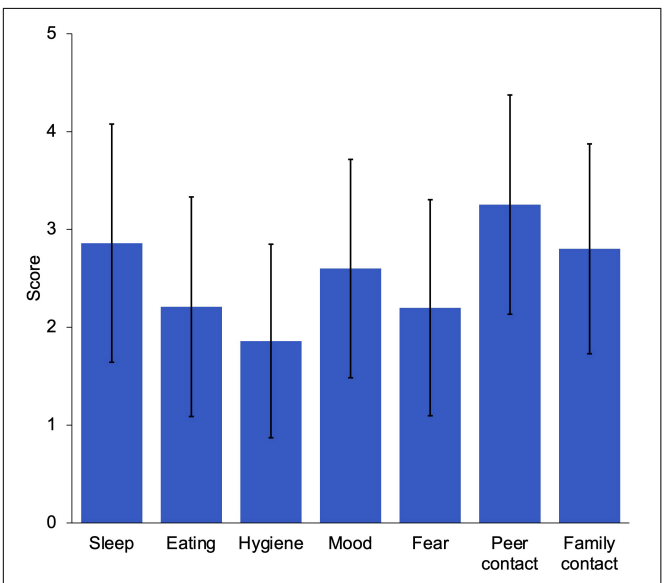

FIGURE 1 | Mean scores and standard deviation in change of children's habits.

Post hoc analyses showed significant differences in emotional symptoms between the third week of confinement and the fourth ($t = -3.333$; $p < 0.05$; $d = 0.332$) and sixth week ($t = -5.883$; $p < 0.001$; $d = 0.517$), as well as between the fifth and sixth week ($t = 3.229$; $p < 0.05$; $d = 0.305$). In the behavioral problems scale, significant differences were found between the third week of confinement and the fourth ($t = -3.561$; $p < 0.005$; $d = 0.348$) and sixth week ($t = -6\text{-}043$; $p < 0.001$; $d = 0.553$), as well as between the fifth and sixth week ($t = -3.476$; $p < 0.005$; $d = 0.335$). Hyperactivity symptoms show statistically significant differences between the third week with the fourth ($t = -3.850$; $p < 0.001$; $d = 0.365$) and sixth ($t = -7.783$; $p < 0.001$; $d = 0.664$). Differences were also found between the fourth ($t = -3.315$; $p < 0.05$; $d = 0.323$) and fifth ($t = -4.408$; $p < 0.001$; $d = 0.438$) weeks with the sixth week of confinement. For the peer problems scale, significant differences were found between the third week

TABLE 3 | Mean scores, standard deviation and differences in points of assessment.

	3rd week		4th week		5th week		6th week		ANOVA		
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	η^2
SDQ	11.14	4.90	13.53	5.27	12.42	5.31	15.08	5.59	25.92	0.00	0.081
Emotional Sx.	3.25	1.61	3.81	1.76	3.59	1.83	4.17	1.93	12.00	0.00	0.039
Behavioral Px.	1.98	1.51	2.53	1.63	2.27	1.68	2.84	1.72	12.90	0.00	0.042
Hyperactivity	4.44	2.51	5.32	2.30	5.02	2.43	6.11	2.51	20.67	0.00	0.066
Peer Px.	1.47	1.47	1.88	1.85	1.55	1.54	1.97	1.72	5.29	0.00	0.018
Pro social	6.00	1.73	6.11	1.63	6.26	1.57	6.26	1.69	1.35	0.26	0.005
Change habits	16.37	4.24	17.73	3.93	17.59	4.40	19.55	4.80	23.39	0.00	0.074
PSS	25.18	8.23	27.09	7.48	25.28	7.41	26.40	8.11	2.91	0.03	0.011
Stressors	18.15	6.78	19.94	6.38	18.35	6.27	19.07	6.59	3.24	0.02	0.011
Rewards	7.03	2.73	7.16	2.28	6.94	2.63	7.34	3.15	0.87	0.46	0.003
R-14	76.72	10.73	74.37	11.80	75.69	11.37	73.47	12.76	3.79	0.01	0.013
Competence	61.66	8.54	59.89	9.23	60.92	8.70	59.83	10.09	2.27	0.08	0.008
Acceptance	15.06	2.83	14.48	3.20	14.77	3.16	13.64	3.45	9.51	0.00	0.031

Sx: symptoms; Px.: problems.

compared to the fourth ($t = -2.659$; $p < 0.05$; $d = 25$) and sixth week ($t = -3.501$; $p < 0.005$; $d = 0.315$). Regarding the overall SDQ score, differences are observed between the third week with the fourth ($t = -4.86$; $p < 0.001$; $d = 0.474$) and sixth ($t = -8.591$; $p < 0.001$; $d = 0.754$). Differences are also found between the fourth ($t = -3.065$; $p < 0.05$; $d = 0.284$) and fifth ($t = -5.028$; $p < 0.001$; $d = 0.485$) week with the sixth week of confinement. For all these variables the effect size is greater for the differences between the third and sixth week, although with a moderate effect size.

Regarding changes in habits, statistically significant differences were observed between the sixth week of confinement with the third ($t = -8.345$; $p < 0.001$; $d = 0.707$), fourth ($t = -4.33$; $p < 0.001$; $d = 0.410$) and fifth ($t = -4.447$; $p < 0.001$; $d = 0.424$) week.

Regarding parental stress scores, statistically significant differences were found between the third and sixth week ($t = -2.593$; $p < 0.05$; $d = 0.242$). As for resilience scores, differences were observed in the self-acceptance scale between the third and sixth week ($t = -5.172$; $p < 0.001$; $d = 0.454$). Similarly, the overall resilience score showed significant differences between the third and sixth weeks ($t = 3.19$; $p < 0.005$; $d = 0.278$).

In order to determine the differences according to age and weeks of confinement a MANOVA was done using points of assessment (scores of different participants in 3rd, 4th, 5th, and 6th week of lockdown) and age by grade level as factors to evaluate the effects of lockdown on the time*children's age relationship in all the assessed variables. A significant effect in this interaction was observed in hyperactivity symptoms evaluated with the SDQ (F (12) = 1.807; $p < 0.05$; $\eta^2 = 0.25$), with a small effect size. In particular, *post hoc* analysis show that this interaction was significant in children between three-to-six years between the fifth and sixth week ($t = 1.722$; $p < 0.001$). In children between 7-to-11 years, significant differences were found between the third week and fourth ($t = 1.089$; $p < 0.005$), fifth ($t = 1.327$; $p < 0.005$) and sixth weeks ($t = 1.516$; $p < 0.001$). No statistically significant differences were found in the rest of the variables.

Correlational Analysis

Table 4 shows statistically significant bivariate correlations between most of the variables. There was no statistically significant correlation between the total change in habits and prosocial behavior scores. The relationships between the parents' personal resilience scores, both total and on subscales, were negative and statistically significant with the rest of variables, except for prosocial behavior, in which the correlation was positive.

Effects of Changes in Habits on the Variables and Linear Regression Analysis

Table 5 illustrates the differences in mean scores and effect sizes of the variables by perception of change in children's habits. Thus, statistically significant differences were found for most of the variables depending on which of the habits was evaluated. Those who reported changes in their children's habits scored higher on difficulties in children's behavior and parental stress. The mean scores in personal competencies of resilience and acceptance of oneself were lower for those who reported more change in habits. The prosocial behavior variable showed statistically significant differences only with change in fears, contact with peers and contact with family members, in which the mean score was low for children of parents who reported changes in those respects.

In a linear regression analysis of the total difficulties score (SDQ) as the dependent variable and changes in children's habits as the independent variable, we found a statistically significant regression model ($F(4.878) = 88.47$; $p < 0.001$), in which the total score on difficulties ($\beta = 0.335$; $t = 5.57$; $p < 0.001$), behavior problems ($\beta = 0.123$; $t = 2.68$; $p < 0.05$), emotional symptoms ($\beta = 0.093$; $t = 2.35$; $p < 0.005$) of the children and resilience competencies of the parents ($\beta = -0.097$; $t = -3.304$; $p < 0.005$) explained 28% (Adjusted $R^2 = 0.284$) of variance in changes in habits.

Mediation Analysis of Resilience as a Mediating Factor Between Parental Stress and Children's Difficulties

Figure 2 shows the mediation model estimated with the standardized means between directly related variables. This model shows the statistically significant positive direct effects between parental stress and emotional symptoms (B = 0.03; Z = 6.97; p < 001; 95% CI [0.022-0.039]), behavior problems (B = 0.05; Z = 12.36; p < 001; 95% CI [0.042-0.058]), hyperactivity (B = 0.04; Z = 9.68; p < 001; 95% CI [0.032-0.048]) and problems with peers (B = 0.028; Z = 6.28; p < 001; 95% CI [0.019-0.036]), and negative for prosocial behavior (B = −0.17; Z = −3.85; p < 001; 95% CI[−0.026–0.008]).

TABLE 4 | Pearson's bivariate correlations.

	PSS	Stressors	Rewards	R-14	Competence	Acceptance	Routines
SDQ	0.477**	0.462**	0.268**	−0.273**	−0.224**	−0.358**	0.520**
Emotional Sx.	0.275**	0.285**	0.112**	−0.139**	−0.099**	−0.225**	0.389**
Behavioral Px.	0.450**	0.421**	0.289**	−0.262**	−0.227**	−0.309**	0.446**
Hyperactivity	0.371**	0.375**	0.171**	−0.208**	−0.163**	−0.293**	0.392**
Peer Px.	0.256**	0.221**	0.211**	−0.170**	−0.155**	−0.178**	0.246**
Pro social	−0.175**	−0.115**	−0.229**	0.204**	0.226**	0.098**	0
PSS		0.945**	0.621**	−0.363**	−0.338**	−0.358**	0.307**
Stressors			0.329**	−0.250**	−0.223**	−0.277**	0.283**
Rewards				−0.446**	−0.441**	−0.370**	0.205**
R-14					0.982**	0.844**	−0.231**
Competence						0.728**	−0.210**
Acceptance							−0.242**

*Sx.: symptoms; Px.: problems; **: p < 0.001.*

TABLE 5a | Mean scores, standard deviation and Student t to evaluate the differences in the variables according to the perception of habit change in the children.

		Sleep habits				Eating habits				Hygiene habits				Change in mood			
		M	*SD*	*t*	*d*	*M*	*SD*	*t*	*d*	*M*	*SD*	*t*	*d*	*M*	*SD*	*t*	*d*
SDQ	*No change*	10.78	4.71	−10.3*	0.712	11.63	5.00	−10.2*	0.712	12.40	5.26	−6.11*	0.488	10.60	4.53	−14.3*	0.966
	Change	14.46	5.45			15.31	5.47			15.01	5.69			15.36	5.29		
Emotional Sx.	*No change*	3.17	1.62	−7.11*	0.489	3.32	1.62	−8.14*	0.567	3.55	1.73	−4.14*	0.33	3.11	1.51	−9.96*	0.670
	Change	4.03	1.86			4.31	1.95			4.15	1.99			4.26	1.91		
Behavioral Px.	*No change*	1.81	1.41	−8.93*	0.614	2.05	1.51	−8.21*	0.571	2.21	1.57	−6.15*	0.491	1.69	1.34	−13.8*	0.929
	Change	2.78	1.70			2.97	1.74			3.01	1.81			3.09	1.66		
Hyperactivity	*No change*	4.35	2.36	−8.46*	0.582	4.73	2.50	−7.40*	0.515	5.03	2.53	−3.85*	0.307	4.30	2.37	−11.2*	0.754
	Change	5.77	2.49			6.00	2.39			5.80	2.45			6.09	2.37		
Peer Px.	*No change*	1.46	1.45	−3.74*	0.257	1.52	1.49	−4.49*	0.312	1.61	1.60	−3.46*	276	1.50	1.47	−3.82*	0.257
	Change	1.88	1.76			2.03	1.86			2.06	1.78			1.92	1.79		
Pro social	*No change*	5.99	1.64	−2.32^	0.160	6.10	1.65	−1.17	0.081	6.13	1.61	−0.39	0.031	6.14	1.67	−0.04	0.003
	Change	6.25	1.68			6.23	1.70			6.19	1.86			6.15	1.67		
PSS	*No change*	24.40	7.68	−4.82*	0.331	24.85	7.60	−5.47*	0.381	25.11	7.70	−5.90*	0.471	23.77	7.39	−8.48*	0.371
	Change	26.99	7.90			27.82	8.10			28.77	7.99			28.11	7.83		
Stressors	*No change*	17.45	6.29	−5.14*	0.353	17.96	6.39	−5.21*	0.636	18.18	6.48	−5.45*	0.435	17.17	6.35	−7.68*	0.517
	Change	19.74	6.60			20.31	6.61			21.00	6.44			20.47	6.38		
Rewards	*No change*	6.94	2.82	−1.60	0.110	6.90	2.58	−3.24*	0.225	6.93	2.61	−3.89*	0.310	6.59	2.51	−5.8*	0.391
	Change	7.24	2.70			7.51	2.97			7.77	3.09			7.65	2.87		
R-14	*No change*	76.31	11.5	2.48^	0.171	75.64	11.4	1.77	0.123	75.82	11.46	3.34*	0.266	77.11	11.19	5.10	0.343
	Change	74.31	11.8			74.20	12.2			72.72	12.32			73.14	11.93		
Competence	*No change*	61.44	8.99	2.16^	0.149	60.92	9.01	1.27	0.088	61.13	9.04	2.99*	0.239	62.07	8.82	4.69*	0.315
	Change	60.08	9.30			60.11	9.50			58.94	9.55			59.20	9.35		
Acceptance	*No change*	14.87	3.15	2.89*	0.199	14.72	3.02	2.85*	0.198	14.70	3.09	3.64*	0.291	15.04	3.01	5.2*	0.350
	Change	14.23	3.21			14.09	3.44			13.77	3.44			13.94	3.28		

*Sx.: symptoms; Px.: problems; *: p < 0.001; ^: p < 0.05.*

With acceptance of oneself as a meditating factor in parental stress, there were statistically significant positive indirect effects on emotional symptoms (B = 0.012; Z = 5.1; p < 001; 95% CI [0.008-0.017]), behavior problems (B = 0.01; Z = 4.43; p < 001; 95% CI [0.005-0.014]), hyperactivity (B = 0.013; Z = 5.64; p < 001; 95% CI [0.009-0.018]) and prosocial behavior (B = 0.008; Z = 3.46; p < 001; 95% CI [0.003-0.012]). However, with personal competence in resilience as a mediator of stress, there were statistically significant negative indirect effects on emotional symptoms (B = −0.008Z = −3.58; p < 001; 95% CI [-0.012-0.017]), hyperactivity (B = −0.007Z = −3.55; p < 001; 95% CI [−0.011- −0.003]) and prosocial behavior (B = −0.013; Z = −5.53; p < 001; 95% CI [0.018-0.008]).

DISCUSSION

At the beginning of the pandemic, there was not yet clear evidence of the cost/benefits of social distancing measures, and specifically, school closures for controlling contagion by COVID-19. However, the urgency of identifying its impact on the children-youth population, and how the routines of parents and children could safely be returned to (especially where family conciliation strategies were needed) due to the economic and psychosocial consequences that this distancing could have on both, was already apparent (Viner et al., 2020). In the first months of the year, the lack of research on this topic was also clear (Orben et al., 2020; Viner et al., 2020), although there was agreement in emphasizing the severity of consequences, especially among the more vulnerable groups, such as the children-youth population (Brooks et al., 2020; Espada et al., 2020; Fore, 2020; Lee, 2020; Liu J. J. et al., 2020; Rosenthal et al., 2020; Viner et al., 2020), noting alteration in routines and stress as two of the factors that most affect physical and psychological wellbeing in a situation of lockdown and social distancing (Balluerka et al., 2020; Wang et al., 2020). Currently, several studies have revealed the negative emotional impact of home confinement in different continents (Ammar et al., 2020b). As mentioned by García Ron and Cuéllar-Flores (2020), although there are expert recommendations for mitigating the negative effects of quarantine, there is still little scientific evidence on the protective factors against the psychological impact that confinement could have on children and adolescents. Therefore, the present study was focused on describing and analyzing the relationship between the difficulties in psychological adjustment and the change of habits of the infant-juvenile population as perceived by their parents and their stress and resilience, as well as to analyze the course of the changes and the relationships between the third and sixth weeks of confinement of the first wave of the COVID-19 in Spain.

TABLE 5b | Mean scores, standard deviation and Student t to evaluate the differences in the variables according to the perception of habit change in the children (cont.).

		Fears				Contact with peers				Contact with relatives			
		M	*SD*	*t*	*d*	*M*	*SD*	*t*	*d*	*M*	*SD*	*t*	*d*
SDQ	*No change*	11.52	4.74	−11.6*	0.818	11.50	5.71	−4.81*	0.311	12.94	5.59	−0.64	0.02
	Change	15.69	5.70			13.51	5.30			13.21	5.09		
Emotional Sx.	*No change*	3.16	1.51	−12.7*	0.899	3.56	1.78	−1.27	0.095	3.70	1.82	0.22	0.130
	Change	4.66	1.92			3.74	1.82			3.67	1.80		
Behavioral Px.	*No change*	2.04	1.48	−8.91*	0.627	2.10	1.64	−3.11*	0.168	2.37	1.66	−0.87	0.055
	Change	3.04	1.78			2.50	1.66			2.48	1.65		
Hyperactivity	*No change*	4.78	2.45	−6.97*	0.490	4.46	2.72	−5.2*	0.339	5.19	2.60	−0.27	0.117
	Change	5.98	2.51			5.46	2.42			5.25	2.31		
Peer Px.	*No change*	1.54	1.53	−4.04*	0.284	1.39	1.48	−3.39*	0.236	1.68	1.67	−1.06	0.202
	Change	2.01	1.82			1.82	1.69			1.82	1.58		
Pro social	*No change*	5.99	1.71	−3.87*	0.272	6.44	1.60	3.09*	0.081	6.23	1.63	2.73*	0.450
	Change	6.44	1.55			6.05	1.68			5.87	1.77		
PSS	*No change*	25.04	7.80	−4.69*	0.330	24.58	8.25	−3.02*	0.112	25.89	8.02	−0.48	0.137
	Change	27.62	7.86			26.42	7.75			26.19	7.58		
Stressors	*No change*	18.07	6.55	−4.67*	0.328	17.62	6.85	−3.22*	0.155	18.88	6.61	0.35	0.025
	Change	20.21	6.40			19.25	6.43			18.69	6.45		
Rewards	*No change*	6.97	2.68	−2.31^	0.162	6.97	2.65	−0.98	0.046	7.01	2.67	−2.24^	0.338
	Change	7.41	2.84			7.18	2.78			7.50	2.96		
R-14	*No change*	75.99	11.29	3.03*	0.213	78.37	10.60	4.88*	0.286	75.59	11.29	2.23^	0.251
	Change	73.50	12.35			74.00	11.90			73.52	12.98		
Competence	*No change*	61.22	8.93	2.63^	0.185	63.21	8.35	4.93*	0.266	61.02	8.79	2.34^	0.271
	Change	59.53	9.59			59.74	9.31			59.31	10.32		
Acceptance	*No change*	14.77	3.06	3.57*	0.251	15.16	3.10	3.69*	0.286	14.57	3.14	1.43	0.140
	Change	13.97	3.39			14.25	3.20			14.21	3.39		

*Sx.: symptoms; Px.: problems; *: p < 0.001; ^: p < 0.05.*

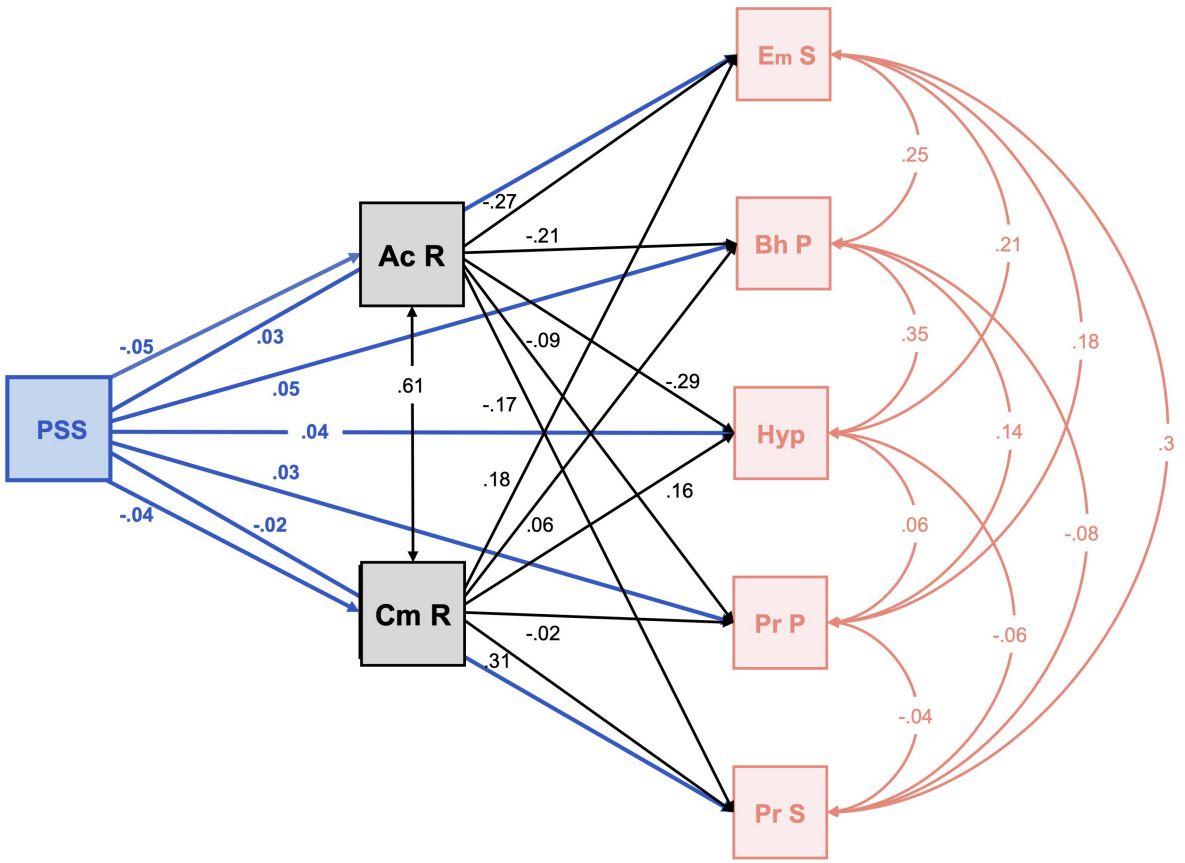

FIGURE 2 | Mediation analysis between parental stress and difficulties in children with resilience as a mediating factor. PPS: parenting stress; Ac R: self-acceptance resilience; Cm P: resilience competences; Em S: emotional symptoms; Bh P: Behavioral problems; Hyp: hyperactivity; Pr P: peer problems; Pr S: prosocial. All lines represents direct effects.

Regarding the descriptive results obtained to meet the first objective of this study, it is globally confirmed that parents perceive a change in the habits of the infant-juvenile population. In particular, these results confirmed a change in the habits of the children-youth population, especially those related to difficulties in contact with peers and family members and sleep problems, coinciding with other studies (Berasategui Sancho et al., 2020; Brooks et al., 2020; Lee, 2020; Orgilés et al., 2020; Serrano-Martínez, 2020). As reviewed by Cifuentes-Faura (2020) school closures can lead to consequences, especially among the most vulnerable, related to eating insecurity or less healthy diets, less physical activity, and more screen use, with negative effects to their mental and physical health, made worse by interaction between changes in lifestyle and psychosocial stress caused by lockdown. Also, a multi-center multi-country study in adults by Ammar et al. (2020a) revealed that physical activity has decreased and sitting hours have increased.

Along with the modification of routines and habits, the results show that parents also perceive psychological difficulties in their children, with cutoff scores showing their problematic susceptibility in emotional symptomatology, behavior problems, hyperactivity, prosocial behavior, and total difficulties, except problems with peers where mean scores were in the ranges of normality. As noted by Quezada-Scholz (2020), the threat COVID-19 poses in different facets of life can generate uncertainty and fear, which in turn, would accelerate disproportionate avoidance and even aggressive behaviors that could explain this perception of behavior difficulties in general and directly related to behavior problems, hyperactivity, and prosocial behavior difficulties.

Some studies have identified emotional symptomatology and symptomatology related it to parental perception of hyperactivity (Orgilés et al., 2020; Tiwari et al., 2020). Over 70% of parents interviewed during lockdown perceived that their children were more nervous and got angry more easily, and over 50% stated that their children cried more than before and were sadder (Berasategui Sancho et al., 2020). Other studies (Serrano-Martínez, 2020) beyond this symptomatology, emphasize emotions of joy, and Berasategui Sancho et al. (2020) underlined emotional ambivalence in childhood. In adults, Balluerka et al. (2020) emphasized the changes in dysphoric mood states (resignation, sadness, uncertainty and fear, and others) and to a lesser extent, also euphoric (the positive side of family life, less stress, normalization of emotions over time, and

others) although referring to prosocial conduct, they highlight behaviors, such as applause for healthcare workers and helping neighbors, and in general, the perception of solidarity and social cohesion.

In the study on parental stress, we confirmed that, although scores were above the mean, families showed moderate stress, with significant differences regarding children's ages, decreasing as the children were older and finding that parents of the smallest children were those who reported the most problems adjusting to this environment. Among the tools and resources recommended for minimizing the effects of lockdown and favoring better social and family coping are the use of information technologies and social communication, as they can supplement the lack of social contact. However, their use is more complicated for the smaller children (Bazán et al., 2020; Brooks et al., 2020; Orben et al., 2020).

At the same time, our results describe parents with a high level of resilience, which is evident in Personal Competence scores above the mean and Acceptance of oneself and of life, slightly below. Characterizing resilience then as a positive personality trait, the families studied showed sufficient capacity to adapt to the adversities arising from lockdown (Wagnild and Young, 1993), where skills developing resilience had more weight than the more intrinsic matters that facilitate its development (Gómez, 2019). Although depending on the type of problem, resilience can vary (Cantero-García and Alonso-Tapia, 2018), these results agree with those found in sports (Trigueros et al., 2017) and with respect to total resilience in a sample of parents of children with disabilities, and in a sample of adults with a motor disability (Suriá Martínez, 2013, 2014, among others).

In view of these results, we can confirm, with respect to our first hypothesis, the presence of psychological adjustment difficulties of parents, children, and adolescents. However, of more interest than the snapshot is the study of changes which occurred as lockdown continued.

Thus, we found that the longer lockdown lasted, the stronger the perception of change in habits, an aspect which has been emphasized in other studies in adult populations (Levy et al., 2020; Ammar et al., 2021), which have shown changes in eating habits, physical exercise, sleep and hygiene, among others, during lockdown. Also, in agreement with previous studies (Brooks et al., 2020; Gómez-Becerra et al., 2020; Sandín et al., 2020), it was confirmed that the duration of lockdown accentuated parents' perception of the psychological difficulties of their children, supporting the second hypothesis. As Gómez-Becerra et al. (2020) mentioned, the symptomatology observed in COVID-19 studies before or at the beginning of lockdown is less than at later times. In this study, only prosocial conduct of children remained stable throughout lockdown, with susceptibility to becoming problematic during the entire period, and finding variability between weeks in problems with peers. As mentioned above, the uncertainty and fear caused by COVID-19 could cause avoidance and aggressive behaviors (Quezada-Scholz, 2020), which along with the lack of social contact during lockdown could explain these results.

We also observed a decrease in resilience, more in the Acceptance of oneself and of life component than in the Personal competence component. That is, lockdown affected acceptance of circumstances and a feeling of peace more than the characteristic skills of the resilient person (Wagnild and Young, 1993), despite experiencing adversity. This could be explained to the extent that perceived stress and its consequent inverse relationship with resilience has a greater effect on the Acceptance component than Competence, probably due to the anomalous situation. As Villaceiros Durbán (2017) demonstrated in her review of studies on resilience, the effect of duration of adversity has contradictory results, and our study is aligned with those that have found a decrease in resilience with persistence of the negative circumstance of life. In view of the above, we can confirm our second hypothesis that psychological adjustment problems would increase with the duration of lockdown.

Moreover, the results reveal that parents perceive different problems depending on the ages of their children, finding more change in habits and more behavior problems and hyperactivity in those under three years old; more emotional and prosocial symptoms from six to twelve and more problems with peers in girls and boys in middle school (12 to 16).

Although there are no studies for comparing our results on the resilience of parents by their children's grade level, the fact that parents showed more resilience as children were older is congruent with those found by other researchers, as in our study (Becoña et al., 2013; Sánchez-Teruel and Robles-Bello, 2015), the age of parents increased as children passed from one grade to another, thereby supporting the idea that resilience is not a static trait, but rather a dynamic process modifiable throughout the life cycle (Villalba Quesada, 2003; Windle, 2011; García Renedo et al., 2013; Sánchez-Teruel and Robles-Bello, 2014; Fernandes de Araújo et al., 2015; Jiménez Pina, 2016; García-León et al., 2019). Furthermore, the presence of higher levels of self-reported resilience of parents with older children (middle and high school) could show, on one hand, the effect of cumulative parental experience, and on the other, the decreasing need for social support (strongly linked to Resilience; e.g., Villaceiros Durbán, 2017; Prime et al., 2020) for caregiving and employment conciliation in bringing up children. However, we should mention that other studies have shown the opposite (Saavedra Guajardo and Villalta Paucar, 2008), in the sense that younger adults are those who have higher scores in resilience then older adults, and even some that explicitly mention the inexistence of significant relationships between demographic variables such as age, for instance, and resilience (Zarzaur et al., 2017).

Regarding the second objective of the study, that is, to analyze the differences in the perception of psychological difficulties and change of habits of the children, according to the age of the children and/or the week of lockdown, we can highlight the following points:

When, in addition, the effects of duration of lockdown and age of children were combined, significant effects were found in parental perception of hyperactivity of children from three to six years. As mentioned by Echeburúa et al. (2004), and reported by Bazán et al. (2020), change in habits and certain emotional symptoms may be a product of lack of skills for understanding the situation and expressing emotions in smaller

children. In the same line, Espada et al. (2020), citing the National Child Traumatic Stress Network, mentioned that nightmares, fear, aggressive behavior, change in appetite and more tantrums, complaints or attachment behaviors could be expectable behavior in children under six years old. Irritability, sleep or appetite problems, physical symptoms, behavior problems, excessive attachment, competition for attention of parents and loss of interest in friends, may be common from six to twelve, and from 13 to 18, physical symptoms, sleep and appetite problems, isolation from friends and loved ones, as well as changes in energy, apathy and loss of interest in health behaviors. As emphasized by Orben et al. (2020), adolescence is a sensitive period of development in which the lack of interaction among peers could have short and long-term effects on social, cognitive and behavioral development, although they also reported the need for more research in this area. As described above, our study results showed difficulties in prosocial behavior and also with regard to changes in fears and contact with peers and family members during lockdown. Considering the information compiled by Espada et al. (2020), the confinement situation due to the pandemic leads to changes in fears and lack of social contact, promotes loss of interest in friends and isolation from them and from loved ones, which could explain the difficulties perceived in prosocial behavior.

In this sense, we can also confirm our third hypothesis related to the influence of children's ages and grade level on parents' perception of their psychological difficulties and changes in habits.

The analysis of family variables confirmed a two-way relationship, in relation to the third objective of the study. The correspondence between change in habits and behavior difficulties showed a two-way relationship between the two, except for the relationship between perception of change in habits and prosocial behavior, where no significant differences were found. Probably, the parental perception of their children's difficulties made it harder to keep up certain routines. Thus, a change in routines could lead to bad temper, frustration and anxiety (Lee, 2020). Specifically, previous studies (León Martínez et al., 2020) have found susceptibility to depressive, anxiety, and eating disorders and to screen addiction, one of the most frequent changes in habits in our study.

This change in habits of children and adolescents, in addition to the behavior problems in this population, are related to parental stress. Thus, management of behavior children's problems (aggressiveness, rebelliousness, social and emotional problems, disobedience) can become a stressful life situation that can increase parental stress as it decreases resilience (Cantero-García and Alonso-Tapia, 2018). The role of parental stress in childhood development and behavior, affects the perception parents have of their children, and this, the quality of couple interaction (Crnic and Low, 2002; Mackintosh et al., 2006; Mitchell and Hauser-Cram, 2010; Fernández-Rodríguez et al., 2015). Mash and Johnston (1990), in their description of the three domains (parents, children and interaction), stated that the presence of stress in any one of them negatively influences the remaining two. Thus, we confirmed, as expected in this context, higher scores in parental stress, difficulties in interaction as mentioned above, such as use of more coercive strategies (Burke et al., 2008; Respler-Herman et al., 2011), more dysfunctional practices, and lower levels of affect and communication (Bonds et al., 2002), as well as children's internalization and externalization problems (Costa et al., 2006). This confirms the fourth hypothesis.

There was a statistically significant negative relationship between the change in habits in children-youth population and parental resilience, suggesting that as parental perception of changes in habits increased, their resilience lessened. In fact, the most resilient parents were those who perceived fewer changes in their children's habits than less resilient parents who reported greater changes in children's routines. In line with these results, resilience is argued as a facilitating element for maintaining family habits and routines during COVID-19 (Prime et al., 2020).

A statistically significant inverse relationship between stress and resilience shown in other studies was also confirmed (hypothesis 5). Focusing on general stress and not a clinical sample, García-León et al. (2019) identified a significant inverse/negative correlation between resilience and depression, anxiety, vulnerability to stress and perceived stress. The same is true of single mothers of adolescents, vulnerable adolescents, mothers with newborn babies, women victims of trauma, and older women, underlining the inverse association between resilience and stress, depression, anxiety, loneliness and desperation (see a review by Wagnild, 2009). This relationship between resilience and stress has also been found in caregivers of patients in hemodialysis (Martínez-Rodríguez et al., 2019). Focusing on parental stress, and derived from studies with a clinical sample, that is parents of children with neurodevelopmental disorders (Cara García, 2019), parents of children with ASD (Jiménez Pina, 2016; Tijeras Iborra, 2017); parents of hyperactive, autistic, intellectually disabled children or who have learning difficulties (Suzuki et al., 2018), physically, intellectually disabled or pluri-disabled and ASD children (Vela Llauradó and Suárez Riveiro, 2020), also back the negative relationship between resilience and stress. As noted by Sánchez-Teruel and Robles-Bello (2014), there are few studies on resilience in non-clinical populations exposed to constant adverse and traumatic situations. And although confinement and social distancing derived from the pandemic have not been nor permanent measures, COVID-19 is beginning to be a constant threat in our lives and a source of stress for the population. There is much evidence on the protective role of resilience against perceived stress (Fernandes de Araújo et al., 2015; García-León et al., 2019), as well as that psychological resources, such as self-esteem, internal control, or coping through emotional search mitigate and can even eliminate the adverse effect of stress and favor resilience. We can therefore confirm the hypothesis asserting that families with higher resilience show less parental stress.

The fourth objective of this study was to evaluate the influence of changes in habits on parental factors and children's problems. The regression analysis performed revealed an explanatory model of change in habits depending on behavior problems, emotional symptoms and total psychological problems of the children, as well as parents' resilience. The results show that parents who report changes in their children's habits perceive more psychological difficulties in their children and more

self-perceived stress than parents who do not perceive these changes in their children's habits, thus confirming hypothesis 6. Thus, keeping or changing routines, understood as managing the family situation, depends on the responses to change and emotional symptoms, spaces for play and lack of social contact, which also vary depending on the level of the child's maturity and development during lockdown, as mentioned by Merino-Navarro and Díaz-Periánez (2020), and the parents' capacity to confront adversity, in this case lockdown, all become predictive factors of the perception of change in children-youth habits.

The fifth objective was to analyze resilience as a mediating factor between parental stress and childhood problems during lockdown. In the mediation analysis, we saw how parental stress had a direct positive effect on children's difficulties. This result has been observed previously in aggressive behavior of adolescents (Cabrera et al., 2012), behavior, social and emotional problems of children with ADHD (Theule et al., 2013; Berenguer et al., 2019), in children with ASD (Romero-González et al., 2020), and others. However, when we included the resilience variable in the analysis, this effect continued in the same direction as acceptance of oneself and of life. That is, when adaptability, balance, flexibility and a stable perspective of life (Factor II of ER-14) acted as a mediator. But the relationship was the opposite with stress, when parents showed personal resilience competencies, that is, self-confidence, independence, decision, ingenuity and perseverance (Factor I of ER-14). Thus, we can suggest that parental skills of resilience and personal competence act as a protective factor or mediator in their children's problems, since with acceptance of oneself and of life, the relationship between parental stress and psychological problems of the children is weakened, and with personal competence in resilience, the relationship is reversed, as it acts as a mediating element in this relationship, becoming a protective factor against the perception of the psychological problems of their children. Therefore, we accept Hypothesis 7, in which resilience of parents mediated the relationship between parental stress and psychological problems of their children. In this line, and from a psychosocial approach in the area of migration, Villaceiros Durbán (2017) analyzed the behavior of resilience as a buffer between migratory stress and psychological health of adolescent migrants, confirming the protective and moderating effect of resilience (family strengths and affective support).

LIMITATIONS OF THE PRESENT STUDY

One limitation of our study is that, although we found whether there was a change in routines related to social contact, sleep or eating, and others, we do not know the direction of the change. The study by Wang et al. (2020) at the beginning of lockdown in China, found that the change in certain habits (specifically, hygiene, such as not using chopsticks at meals or washing hands) was associated with lower scores on the psychological impact scales and stress, depression and anxiety symptoms in those surveyed over 21 years of age. Another limitation and future directions would be the fact that, as in most research studies in the family setting, most of the participants are women. Finally, it would have been relevant to carry out a longitudinal follow-up of the families participating in the study. The research methodology used for collecting data, as well as the ethical considerations regarding the anonymity of the families did not make it possible. To solve this problem, the data were compared differentially according to the week of the confinement period (i.e., whether it was the third or the sixth week) in which the surveys were carried out.

CONCLUSION AND PRACTICAL IMPLICATIONS

The conclusions that can be derived from this study suggest that lockdown caused by COVID-19 has had a considerable effect on families, both on children and parents, which has been reflected in higher levels of stress and different types of difficulties. This effect has grown as the duration of lockdown has continued, and so we celebrate government decisions around the world to moderate confinement for children. What has been suggested as an economic requirement is also an emotional one. The fact that all families have not coped with this situation with the same efficacy, since those who have been able to provide a stable setting managing routines of activities, leisure, hygiene and sleep had lower scores in stress and childhood difficulties provides us with a guide for intervention as psychology and education professionals.

The results obtained suggest that the guidelines that should be indicated to families would be in the following direction:

(1) Parents should practice or learn emotional regulation strategies that allow them to reduce their parental stress and organize their families in order to reduce stress and overburden in childcare and parenting.
(2) They should practice their resilience skills, either in their strengths, already applied in other adverse situations. They should either work on their resilience under the guidance of psychologists to improve their coping strategies, their acceptance skills, their tolerance to discomfort and frustration, and their capacity for psychological flexibility (cognitive and behavioral).
(3) Parents should organize their children's schedules, routines and activities in a confinement period, by applying variability, rest times, avoiding saturation or overdoses of any activity (neither academic, nor video games, nor television, etc.), being creative in the development of innovative activities for their children, such as the use of information technologies to supply the lack of social contact, special systematization in playing with them and sharing common interests.
(4) Finally, parents should be careful about the type of information provided to their children about the pandemic situation, avoiding negative, bleak, catastrophic, or fear-based information. On the contrary, parents should encourage intelligent optimism (e.g., even though in this confinement they cannot do what they would like to do, it may be an opportunity to learn new activities, to share more time with parents, etc.). On the other hand, parents should raise their children's awareness of their own

resilience, encourage their attitudes of solidarity and gratitude, etc.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Bioethic Committee of University of Almería (Spain). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

PS-L was involved in the management of the research project and the ethical permissions. IG-B worked on the development and supervision of the design of methodology. JF-C was involved in data curation and formal analysis. MA-R and MF-T wrote the original draft introduction and conclusions of the study. All authors were involved in the design of the study, writing of the final review and editing, and contributed equally to this study.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Appendix 1. Self-Report Habits *of Everyday Living*

Here are a few questions about your children's everyday habits and how much you think they changed during lockdown?

Please select **only one** of the following options:

(1) Not at all, (2) Not much, (3) Neutral, (4) Somewhat (5) Very much

1. To what extent have you noticed in the last two weeks if your child had difficulty to maintain his/her **sleep routines**?
2. To what extent have you noticed in the last two weeks if your child had difficulty to maintain his/her **eating habits**?
3. To what extent have you noticed in the last two weeks if your child had difficulty to maintain his/her **hygiene habits**?
4. To what extent have you noticed in the last two weeks if your child had difficulty to maintain a **stable mood**?
5. To what extent have you noticed in the last two weeks if your child has **felt afraid**?
6. To what extent have you noticed in the last two weeks whether your child has **kept in contact with friends and/or classmates**?
7. To what extent have you noticed in the last two weeks if your child **has kept in contact with family members who are not at home**?

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Experiences With Online Teaching and Psychological Adjustment of High-School Students at the Onset of the COVID-19 Pandemic in Croatia

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Vastly changed schooling arrangements due to the COVID-19 crisis have generally limited the opportunities and resources for schools to provide necessary psychological and other support to their students. Given this, all parties involved in the schooling system need to understand the kinds of experiences students have via distance learning and how students adapt to novel living and studying conditions. This study examines the relevant sources of stress that students encounter with regard to online classes, and the frustrations they face due to living in social isolation, as well as how these stressors relate to the measures of students' emotional wellbeing and psychological adjustment. Data were collected in April 2020 via an online questionnaire administered to a sample of 4,492 students (62.6% female) attending all four grades of high school within two Croatian counties. The results point to the differential effects of particular aspects of online teaching practices on the stressful experiences of students. Furthermore, the results of multivariate analysis of variance and canonical discriminant analyses demonstrated notable gender and grade differences in the structure of students' emotional and behavioral adaptation to the health crisis. Female students and those predominantly studying at the highest grade reported higher frequency and intensity of short-term emotional and psychosomatic difficulties. Male students in the final grade year scored highest on the dimension defined by the number and intensity of online teaching stressors. The results are interesting in light of hypothetical accounts of adjustment mechanisms based on existing stress theories. Moreover, the findings serve as a basis for teachers' self-reflection and self-evaluation of schools, which can then lead to designing specific programs of support in learning and adaptation to the new living and studying conditions.

Keywords: COVID-19, educational stressors, emotional health, adaptation, Croatian high-school students, gender and grade differences

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INTRODUCTION

The COVID-19 pandemic is creating significant turbulence in the lives of individuals and societies worldwide. This health emergency has critically impacted all segments of contemporary societies, including every level of the schooling system. The vital implementation of various social distancing measures has meant the partial or total closure of schools and a shift from regular face-to-face

teaching to online teaching. This major alteration in instruction and learning practices has impacted the vast majority of educational institutions worldwide (Alemany-Arrebola et al., 2020; Rettie and Daniels, 2020; Toquero, 2020; UNESCO, 2020; Yan, 2020).

From the perspective of youth mental health care, the importance of schools cannot be overemphasized. Schools play a unique role in ensuring a healthy and safe environment for their students. In this sense, schools provide necessary support for the development of individual capacities and other personal qualities of students. Realization of potential is a basis for the productive and healthy life of any young person, and this is frequently stressed as a priority of modern education (Wentzel, 1998; Anderman, 2002; Klem and Connell, 2004; Shochet et al., 2006; Bezinović and Tkalčić, 2017). To achieve this goal, schools are expected to foster students' cognitive, socio-emotional, cultural, and physical growth in accordance with the capabilities and interests of each individual student. Significant changes to schooling arrangements due to the COVID-19 crisis have generally limited schools' opportunities and resources to provide psychological and other support to their students. In such circumstances, all parties involved in the schooling system need to understand students' experiences with distance learning and how they adapt to novel living and studying conditions.

Considerable empirical evidence has already been collected on the diverse emotional, health, and other consequences of the global COVID-19 crisis (e.g., Cachón-Zagalaz et al., 2020; Rettie and Daniels, 2020; Saha et al., 2020; Taylor et al., 2020; Valadez et al., 2020; Xin et al., 2020). Studies have reported heightened levels of stress, and unfavorable psychological states such as negative affect, symptoms of anxiety and depression, and violent, hostile, and addictive behavior, all of which have been found in the general population as well as among students and adolescents since the onset of the global pandemic (Alemany-Arrebola et al., 2020; Dubey et al., 2020; Li H. Y.et al., 2020; Li X. et al., 2020; McCracken et al., 2020; Richter, 2020). These findings are not surprising given the huge cumulative scientific evidence about general stress, health, and adaptation processes (see, e.g., Lazarus, 2000; Schneiderman et al., 2005). Moreover, while the COVID-19 health risk can be a severe stressor by itself, all the rapid and significant changes in the daily lives of people arising from the emergency have presented additional and potentially serious sources of stress.

Adolescents and high-school students seem to have been especially affected by these abrupt changes to daily life, predominantly due to school closures. On the one hand, the usual structure of school activities and daily routines has been lost; on the other hand, the multitude of experiences that normally occur through intensive social interactions with peers and authorities outside of family have become scarce. Due to features specific to their developmental stage, late adolescents are probably the most sensitive to these various kinds of social deprivation (Wentzel, 1998; Anderman, 2002; Klem and Connell, 2004; Roviš and Bezinović, 2011; Wentzel et al., 2018; Kuhfeld et al., 2020). In addition, such threats might be even more intensely experienced by students in the final grade year of high school. This appears to be primarily due to the practical circumstances of living and studying during the so-called first COVID-19 wave, which led to uncertainties about completion of schooling, the timing and form of final graduation exams, and the prospects of university admission for all individuals planning to continue into higher education.

Therefore, it is interesting and of practical importance to focus on high-school students' stressful experiences in order to gain insights into how they are coping with profoundly changed living and learning circumstances. This study was begun in the initial weeks of online schooling in Croatia, and it is the first piece of research to provide systematic empirical data from Croatia on the effects of school closure as a source of stress and the assessment of online teaching from the students' perspective. Consequently, our findings served as a platform for creating specific education policy measures by the Croatian Ministry of Science and Education.

We conceptualized the study based on the well-known Lazarus transactional stress and coping perspective (Lazarus and Folkman, 1984; Lazarus, 2000), drawing particularly on its cognitivist and contextual understanding of the stress processes. The cognitivist perspective of the Lazarus theory holds that not only objective circumstances, but also subjective appraisals of situations, are the key determinants of how an individual handles situational demands. Hence, adequate predictions of adjustment to specific stressful circumstances require taking into account the unique adaptive demands of the situation and the associated cognitive appraisals used by individuals in interpreting the personal meaning of these demands. Moreover, the contextual character of the theory is manifested in the notion that transient situation-based factors, rather than personal dispositions, are assumed to shape individuals' responses, choice of coping with situational demands, and resulting adaptation outcomes. Relatively stable personal, social, and/or environmental influences are expected to play only an indirect role in this process and are regarded as the antecedents of situational appraisals and coping responses.

Relying on this general stress and coping framework, our study focused on the issues of stressfulness or, in terms of Lazarus's theory, the primary cognitive appraisals of various aspects of studying and living at the onset of the pandemic, and the relationships of these appraisals with indices of wellbeing in high-school students. We aimed to explore the relevant sources of stress that students encounter with regard to online classes and the frustrations of living in social isolation, as well as how these stressors relate to the measures of students' emotional wellbeing and psychological adjustment. As the main study question, we intended to examine the structure of differences in reported stressful experiences and the indices of emotional and behavioral adaptation to the changed living conditions as a function of the grade level and gender of students.

Based on plentiful theoretical and empirical literature in the area of stress and coping (e.g., Endler et al., 2000; Lazarus, 2000; Somerfield and McCrae, 2000; DeLongis and Holtzman, 2005; Scherer and Moors, 2019), we hypothesized substantial positive relationships between reported sources of stress and indices of emotional distress, as well as negative relations of these variables with the measure of effective adjustment to stressful situations.

Furthermore, we expected significant gender and grade-level differences in the extent and intensity of stress experiences generated by sudden changes in living and learning conditions. No expectations were stated with regard to specific sorts of events being experienced by students as more or less stressful, although generally higher levels of stress appraisals and more frequently occurring indices of emotional distress were predicted to be reported more by female students than by male students.

METHODS

This study was designed as a response to the initiative of the professional organizations of school psychologists of the Istrian County of the Republic of Croatia, following recommendations by the Ministry of Science and Education of the Republic of Croatia. The principal objective of this initiative was to gain an insight into the experiences of high-school students with the immensely changed living and learning circumstances due to the onset of the COVID-19 pandemic. The administration of the study was accomplished as part of regularly scheduled school activities. A multivariate cross-sectional correlational design was implemented to examine the main study questions.

Participants

A total of 4,492 students (62.6% female) attending 21 high schools in the regions of Istria and Primorsko-Goranska participated in the study. The sample consisted of students from the first (28.9%), second (26.1%), third (25.2%), and fourth (19.8%) grades in secondary schools, covering the age range of 15–19 years. Students attending grammar schools and professional high schools from these regions took part in the study. Given the sample size and general demographic figures, the sample is a good representation of the high-school student population in the two regions and, to a considerable extent, the Croatian adolescent population of that age. The sample is not very well balanced by gender, as it consists of a somewhat larger proportion of females than would be expected by population values.

Instruments and Procedures

The data were collected during April 2020 via an online questionnaire prepared using the SurveyGizmo (now Alchemer) Internet platform. The entire instrument was designed and adapted specifically for the present study, with selected scales and items being taken in more or less equivalent (original) form from the extensive questionnaire entitled "Kako si? [How are you?]" which was developed and extensively validated within the long-term project on "Risk behaviors, lifestyles, and adjustment of highs-school students" (2001–2019) led by the second author of this study (e.g., Bezinović and Buško, 2008; Bezinović and Malatestinić, 2009; Roviš and Bezinović, 2011; Bezinović, 2016; Bezinović and Tkalčić, 2017). This applies to most of the questionnaire content not explicitly related to the events or stressors due to the current pandemic. The questionnaire consisted of five main sections:

1. *Stressful experiences with distance learning*. The first part of the questionnaire comprised 14 items describing possible sources of stress related to different aspects of online schooling. Students were to appraise how stressful they personally found each of the presented problems. Answers were given with reference to the preceding 2-week period using a Likert-type scale ranging from "not at all stressful" (0) to "extremely stressful" (3). The internal consistency of this group of 14 items as measured by Cronbach's alpha was 0.89.
2. *Hindrances of life in social isolation*. These five items represented possible obstacles and worries students might have faced due to social isolation during the prior 2 weeks. The same four-point Likert-type response format was used. Cronbach's alpha for this set of questions was 0.78. The content of all the items covered by the first two sections of the questionnaire (i.e., this one and that described above) is listed in **Table 1**.
3. *Threats to emotional health*. Ten items were selected to cover a range of unpleasant emotional states, including anxiety, sadness, loneliness, and psychosomatic symptoms (e.g., "I felt helpless"). Students appraised, using a four-point frequency scale from "never" (0) to "very often" (3), how often they had experienced these states in a described manner during the previous 2 weeks. Cronbach's alpha for this set of questions was 0.88.

TABLE 1 | Types and intensity of stressful experiences with distance learning and life in social isolation by gender.

Stressful experiences with distance learning	Female	Male
Demanding school assignments in various subjects	69,7%	59,3%
Acquiring difficult study contents	56,4%	43,9%
Meeting deadlines to complete all study tasks	52,6%	46,1%
Uncertainty about return to schools	52,0%	35,8%
Missing live lectures	51,6%	39,0%
Handling many "posts" in virtual classrooms	44,2%	35,1%
Learning uninteresting content	42,9%	38,2%
Learning unaided from many different sources	40,5%	31,7%
Missing concentration during online lectures	35,9%	27,0%
Acquiring digital technology needed for online learning	27,9%	20,1%
Online communication with teachers	20,8%	17,3%
Inadequate conditions for learning (e.g., missing quiet room, free PC, internet access)	18,9%	15,3%
High parental expectations regarding school obligations	16,3%	17,2%
Receiving feedback from teachers	15,7%	14,1%
Hindrances of life in social isolation		
Restrictions in meeting friends live	81.4%	72.6%
Missing free-time activities	65.0%	59.7%
Confinement at home	61.4%	46.9%
Concern that I will not achieve the kind of school success I want	58.1%	41.4%
Spending all day in the same space as family members	38.5%	32,0%

N varies to some extent depending on the total number of participants with an answer on each item. Percentages denote % of subsamples with answers 2 ('considerably') and 3 ('extremely stressful') to each item. Mean differences/differences in proportions for all but the two last items are significant with $p < 0.01$. Girls demonstrate higher level of stress experiences.

4. *Adjustment to new life circumstances*. Six items examined general adaptability in an emergency situation, including feelings of competence, optimism, and contentment (e.g., "I was able to focus on learning and my homework"). This measure was used as a composite indicator of emotional and cognitive wellbeing following its recently proposed conceptual definition (Ross et al., 2020). Appraisals of items in this section were done using a four-point Likert-type format ranging from "does not apply to me at all" (0) to "fully applies to me" (3), with reference to the preceding 2-week period. Cronbach's alpha for these items was 0.78.
5. Several pieces of basic sociodemographic data were also collected: information on the region (Istria or Primorsko-Goranska), the mother language of participants (Croatian or Italian), type of school, school level (first to fourth grade of secondary school), and gender.

The schools received the link through which each student could access the e-questionnaire and take part in the study. In schools where teaching was in Italian, appropriate translations of the questionnaires were administered. The study was conducted with the approval of liable county bodies and in accordance with the regulations of the Croatian Ethical Codex of Research on Youth, and the Research Ethics Codex of the Department of Psychology, University of Zagreb. Participation in the study was anonymous and fully voluntary with an option to resign at any time during completion of the questionnaire. By accepting to fill in the instrument, students gave their consent to take part in this study. Apart from the time it took to answer several open-ended questions, which we do not analyze in detail in this study, the completion of the questionnaire took approximately 15 min.

Data Analysis

Along with descriptive and reliability statistics of all the study variables, we performed item-level principal component analyses with promax rotation as an auxiliary check of the structure of the data to be of use in defining composite study variables. Multivariate analysis of variance (MANOVA) and canonical discriminant analyses were conducted to answer the main study questions. All the analyses were done using IBM SPSS statistical software, v. 24.0.

RESULTS

The main study results are based on composite scale scores on the key variables analyzed in response to the study questions. An account of these findings is preceded by a brief outline of students' ratings of a range of specific sources of stress they might have experienced within a 2-week period. **Table 1** (with figures given separately by gender) presents elementary descriptive data on sets of items describing stressors potentially generated by conditions of online learning and life in social isolation.

Following the proportions of students who rated different distance-schooling situations as considerably and/or extremely stressful, the most salient source of stress, in both female (69.7%) and male (59.3%) participants, appears to have been students' overload due to many assignments in various subjects. Likewise, acquiring difficult study contents (56.4% of female students; 43.9% of male students) and meeting deadlines for completion of all study tasks (52.6% of female students; 46.1% of male students) were also reported as rather stressful. Other aspects of distance learning were reported to be somewhat less stressful, with items describing parental expectations and getting feedback from teachers being rated as the least taxing by both genders (14.1 to 17.2%). As can be seen, female students generally reported higher levels of stress experiences than did male students, except for the two situations appraised as least stressful where no significant gender differences were observed.

All five presented aspects of life in social isolation were rated as considerably or extremely stressful by a substantial number of students, with obvious differences observed between genders and specific sources of frustration. Again, girls showed significantly higher levels of stressfulness on all items compared to boys. Based on the proportions obtained, restrictions in meeting friends and hanging out appears to have posed the largest difficulties to both female (81.4%) and male (72.6%) students. Conversely, conditions of spending most of the time with family members in the same area was rated as the least demanding aspect by both genders (38.5% of female students; 32% of male students).

The main descriptive statistics of the four composite study variables are shown in **Table 2**. Comparing the mean composite scores on the two scales comprising different sources of recent situational pressures, limitations of life in social isolation seem to elicit on average visibly higher level of stress experiences among students (M = 1.71, SD = 0.76) than the various conditions of distance learning (M = 1.19, SD = 0.61). The results on the emotion scale, used as a measure of threats to emotional health, suggest that the level or rate of recurrence of short-term unpleasant emotional states in students was on average relatively low (M = 1.07, SD = 0.68), with the mean score corresponding to the item scale point of "rarely." Moreover, the results obtained on the remaining measure of overall adaptability suggest that high-school students are on average reasonably well adjusted to these sudden and unfamiliar living and studying circumstances (M = 1.86, SD = 0.62).

Both measures of stressful experiences showed substantially high positive correlations with scores on the scale for short-term emotional state, and somewhat lower, albeit also significant, negative correlations of moderate size with the measure for overall adjustment to the situation. The shape of distributions of variables and the indices of asymmetry and kurtosis indicates a certain departure from normality; however, these values varied within the tolerable range and, given the rather large sample and subsample sizes, the implementation of further multivariate data analyses appeared to be warranted.

To examine the differences in reported stressful experiences as well as in emotional and behavioral reactions to novel living conditions as a function of gender and the grade level of students, we performed MANOVA, implementing the factorial 2 × 4 design (e.g., Huberty and Olejnik, 2006). The analysis revealed significant main effects of both gender (Wilks' $\Lambda = 0.85$, $F[4, 4271] = 187.92$, $p < 0.001$, partial $\eta^2 = 0.150$) and grade (Wilks' $\Lambda = 0.96$, $F[12, 11300.29] = 11.630$, $p < 0.001$, partial $\eta^2 = 0.011$,

TABLE 2 | Main descriptive statistics and intercorrelations of the composite scale scores.

Scales	*N*	Mean	*SD*	Skewness	Kurtosis	Correlation			*k*	Cronbach alpha
						2.	3.	4.		
(1) Distance learning	4483	1.19	0.61	0,389	–0,244	0,582	0,507	–0,481	14	0.89
(2) Emotional distress	4449	1.07	0.68	0,552	–0,293	–	0,542	–0,454	10	0.88
(3) Social isolation	4418	1.71	0.76	–0,269	–0,730		–	–0,296	5	0.78
(4) Adjustment to situation	4426	1.86	0.62	–0,533	0,289			–	6	0.78

N varies to some extent depending on the total number of participants with complete answers on all items of the respective scales. Summative scores on all scales are divided by the number of items to simplify scale comparisons and interpretations; total scores on all scales vary in the observed range of 0-3; Scales: (1) Stressful experiences with distance learning, (2) Threats to emotional health: emotional and psychosomatic problems, (3) Hindrances of life in social isolation, (4) Adjustment to new life circumstances; k, number of items per scale; all correlations are significant at $p < 0.001$.

Roy's GCR = 0.032, $F[4, 4273] = 34.51$, $p < 0.001$, partial $\eta^2 = 0.031$), with the gender x grade interaction found to be marginally significant (Wilks' $\Lambda = 0.99$, $F[12, 11300.29] = 1.57$, $p = 0.092$, Roy's GCR = 0.003, $F(4, 4273) = 3.199$, $p = 0.012$, partial $\eta^2 = 0.003$).

Following the outcomes of the multivariate tests, canonical discriminant analysis was performed as a standard procedure accompanying MANOVA to explain the nature of multivariate group differences (e.g., Bray and Maxwell, 1985; Nesselroade and Cattell, 1988). Both factors of gender and grade level were taken into account to define the variable of group membership in discriminant analysis, thereby enabling a thorough account of observed variability in stress appraisals and reactions to stressful circumstances. The same four discriminant variables were used (two composite measures of appraisals of stressors, that is, distance learning and social isolation, and outcome measures of emotional distress and adjustment to situation) and groups were defined by gender and cohorts of students (hence, eight groups were created in total). The analysis yielded two significant canonical discriminant functions accounting for almost all examined variability between the eight groups of students (99.4% of intergroup variance) in the space of the four stress and adjustment discriminant variables (**Table 3**).

All the parameters presented in **Table 3** indicate significant though not particularly marked differences between the eight groups of students, with the most discriminant power being attributable to the first discriminant function (91.1% of total intergroup variability). As shown in the table, canonical correlation and Wilks' lambda obtained even for the first discriminant function point to moderate intergroup differences ($r = 0.411$, $\Lambda = 0.815$). The meaning of the derived functions and relative positions of the eight groups in the two-dimensional space are presented in **Tables 4**, **5**.

The first discriminant function is primarily defined by scores on the emotional distress measure, whereas the contribution of the remaining scales to the discriminant scores on this function is sizably smaller or negligible. High scores on this function are attained by those who reported frequent occurrence of unpleasant emotional states or various psychosomatic symptoms within the 2-week period. The second discriminant function is predominantly defined by the measure of stressful experiences with distance learning; here too, the role of the other discriminant variables is negligible. Participants who reported high levels of stress experienced due to various aspects of online schooling attained high scores on the second discriminant function.

Analogous to the discriminant function parameters, the obtained range of group centroid values, presented in **Table 5**, demonstrates that the groups of students differ to a considerably larger extent on the first discriminant function than they do on the second. The first function opposes male and female groups of students, with the group of male students attending the first grade of high school scoring lowest ($C_5 = -0.739$), and the female group attending the final grade of high school having the highest centroid score on the function ($C_4 = 0.474$). Centroids

TABLE 3 | Significance tests, eigenvalues (λ), Wilks' Λ, and canonical correlations of the discriminant functions for groups defined by gender and cohorts of students.

Function	Canonical correlation	Eigenvalue (λ)	Wilks' Λ	Chi-Square	*df*	*p*
1	0.411	0.203	0.815	874.89	28	<0.0001
2	0.135	0.019	0.980	84.55	18	<0.0001
3	0.032	0.001	0.999	6.09	10	ns

df, degrees of freedom; p, significance of the Chi-Square test.

TABLE 4 | Standardized discriminant function coefficients and structure coefficients for the two significant canonical discriminant functions with groups defined by gender and cohorts of students.

	Function 1		Function 2	
Discriminant variable	Standardized coefficients	Correlations	Standardized coefficients	Correlations
(1) Distance learning	–0.046	0.402	1.293	0.854
(2) Emotional distress	1.164	0.925	–0.420	0.114
(3) Social isolation	–0.035	0.422	–0.279	0.103
(4) Adjustment to situation	0.412	–0.107	0.127	–0.218

Structure coefficients are computed as pooled within-groups correlations between discriminant variables and standardized canonical discriminant functions; Variables: (1) Stressful experiences with distance learning, (2) Threats to emotional health: emotional and psychosomatic problems, (3) Hindrances of life in social isolation, (4) Adjustment to new life circumstances.

TABLE 5 | Positions of groups centroids on the two significant canonical discriminant functions.

Group			Function 1	Function 2
			Group centroid	Group centroid
n	Gender	Grade		
(1) 764	F	1	0,153	–0,138
(2) 696	F	2	0,369	–0,024
(3) 676	F	3	0,368	–0,046
(4) 564	F	4	0,474	0,138
(5) 476	M	1	–0,739	–0,158
(6) 415	M	2	–0,558	–0,016
(7) 407	M	3	–0,553	0,162
(8) 284	M	4	–0,287	0,322

N = 4282 (cases with missing gender and/or grade codes and those with missing value on at least one discriminant variable are excluded from the analysis); n, group sizes; F, female; M, male.

of most of the groups on the second function are positioned around zero, with the only group standing out with a somewhat higher centroid score is that comprising the senior male students ($C_8 = 0.322$).

DISCUSSION AND CONCLUSION

This study was designed to examine the types and intensity of stress experienced and reported by high-school students in the course of distance learning and living in social isolation. In addition, the aim of the study was to investigate the relationships of stressor appraisals with the emotional wellbeing and psychological adjustment of students. We also examined the structure of grade and gender differences in students' stress experiences and the specified emotional and behavioral outcome measures. The study hypotheses and interpretations are based on general stress and coping theory (Lazarus and Folkman, 1984; Lazarus, 2000) and the accumulated scientific evidence in the area of stress and adaptation mechanisms.

Descriptive analyses performed on the individual items reveal that a considerable proportion of students of both genders reported rather intensive stress experienced due both to different aspects of online learning and to frustrations of life in social isolation. Nevertheless, ample variations were observed among different sorts of stressors in terms of appraised intensity. Thus, the stressfulness of specific distance-schooling situations ranged from the least stressful source reported by around 15% of the sample for receiving feedback from teachers, to stressors reported by 50–70% of the sample, which include situations of uncertainty about return to schools, missing live lectures, acquiring difficult study contents, assignment overload, meeting deadlines, and so on. Further, the stressfulness of conditions of social isolation varied within a somewhat narrower range, from spending most of the time with family members, which was estimated as the least challenging by both female (38.5%) and male (32%) subsamples, to restrictions on meeting friends live, which was declared as a serious source of problem by the largest proportions of female (81.4%) and male (72.6%) students.

It should, however, be noted that the composite scale scores offer a somewhat different picture of the obtained results. Thus, based on the summative scores, both the amount of stress experienced due to situations of distance learning and the emotional distress experienced in the same period, used as a short-term outcome measure, seem to be rather modest. The same applies to the remaining outcome measure – overall adjustment to the current situation, which was used as a composite indicator of emotional and cognitive wellbeing. Students seem to have been reasonably well adjusted to the changes in life circumstances, including being mainly optimistic about the situation and generally capable of overcoming the difficulties and controlling their own behavior. Moreover, this study's results on both outcome measures do not indicate a higher frequency or intensity of unpleasant emotions or other adjustment difficulties in students, compared to overall scores on analogous indices of wellbeing pertaining to practically the same high-school student population and obtained in prior and relatively recent studies that were conducted before the onset of the COVID-19 crisis worldwide (e.g., Bezinović and Tkalčić, 2017). While these are certainly positive and encouraging findings, which have also been reported in other studies (Zacher and Rudolph, 2020), adequate understanding of such a result requires taking into account the timing of the data collection. Our study was conducted at the very beginning of the COVID-19 crisis in Croatia, and most of the sample data were completed in early April 2020, which mainly corresponds to the timing of the second and third measurement points presented in Zacher and Rudolph's (2020) longitudinal study. These authors found no changes in life satisfaction, positive affect, and negative affect in a sample from the adult German population between December 2019 and March 2020. However, a significant decrease in all three subjective wellbeing measures was detected in the same study for the data between March and May 2020. Similar inferences can be derived from other recent studies showing an increase in mental health difficulties during the pandemic, compared to previous general population data (Rettie and Daniels, 2020), increases in negative affect and symptoms of anxiety and depression across the confinement period among the Chinese college population (Li H. Y.et al., 2020), or increases in mental health symptomatology concerns recorded on social media in the 2-month COVID-19 period compared to a similar period in the previous year (Saha et al., 2020).

It should also be mentioned that the observed scores on all the variables in our study cover the full range of scale results, which, together with the other descriptive statistics, indicates large inter-individual variability in the examined stress-related measures. Both sets of results are interesting in terms of weighing the extent of pandemic-related psychological effects in specific populations (e.g., Alemany-Arrebola et al., 2020; Cachón-Zagalaz et al., 2020; Dubey et al., 2020; Li H. Y.et al., 2020; Li X. et al., 2020; Richter, 2020; Saha et al., 2020). Nevertheless, the individual differences are expected and understandable from the perspective of Lazarus's transactional theory, especially considering its cognitivist character, which is manifested in the emphasis put

on the evaluative cognitive processes in explaining stress and adjustment phenomena (Lazarus and Folkman, 1984). Hence, although all students are exposed to objectively comparable learning conditions, individual perceptions make the same situations more or less taxing, which consequently can lead to corresponding individual differences in adaptational outcomes.

The correlations between stress appraisal and outcome measures substantiate such interpretations based on Lazarus's theory, and they support our hypotheses on the pattern of relationships among the main study variables. In other words, the theory foresees that the more the actual events or circumstances are appraised by a person as taxing and stressful, the higher the demands on his/her adaptive capacities are and, consequently, the lower the prospects for the adjustment to be effective are (see e.g., Lazarus and Folkman, 1984). Our results confirm the expected relatively high positive links between reported stress intensity, including measures of both categories of sources of stress, and the intensity of negative emotions as a short-term adaptational outcome measure. Likewise, the results confirm the negative, although somewhat lower, correlations of the stress intensity variables with the measure of effective adjustment to stressful situations. The observed differences in the size of correlations might be the result of the conceptual meaning of the outcome measures used; namely, both operationalizations were intended to serve as short-term outcome measures, at least according to the time frame given for answering the scales and specified in the instructions to the questionnaire. However, the measure of adjustment to situation includes items referring to, for example, sense of competence, self-efficacy, or optimistic views – that is, variables reflecting to some extent trait-like characteristics – so it may be less liable to transitory and contextual changes than is the emotional states measure.

Apart from being theoretically meaningful, our results are in line with the rich empirical literature on the general stress and adjustment processes (e.g., Endler et al., 2000; Lazarus, 2000; DeLongis and Holtzman, 2005; Schneiderman et al., 2005; Wentzel et al., 2018). Moreover, several other recent studies dealing with COVID-19 related stressors have reported relationships of equal sign and comparable size between a range of operationalizations of stress experiences and specific psychological states measures or variously defined behavioral, health, or performance outcomes (e.g., Alemany-Arrebola et al., 2020; McCracken et al., 2020; Valadez et al., 2020; Xin et al., 2020).

Lastly, the results demonstrate significant grade and gender differences in the analyzed set of stress and adjustment variables, with the observed multivariate differences attributable to gender being of a noticeably larger extent than those attributable to students' grade. As shown by the results of the discriminant analysis, two derived latent dimensions accounted for the observed intergroup variability, with the first discriminant dimensions being defined principally by the scores on the emotional distress outcome measure, and the second function by the scores on the measure of stressors related to distance learning. As hypothesized, female students and those predominantly studying at the highest grade levels reported higher frequency and intensity of short-term emotional and psychosomatic difficulties. The results for the first function are expected and consistent with an extensive body of empirical literature showing the same direction of gender differences in a number of stress-related outcomes (Schneiderman et al., 2005; Alemany-Arrebola et al., 2020; Valadez et al., 2020). However, male students at the final grade level scored highest on the dimension defined by the intensity of online teaching stressors. These last findings, although not anticipated, are explicable due to senior students, at the time of this study, being exposed to several additional sources of potential stressors that were partly generated by uncertainties about the timing and form of final graduation exams, and partly by procedures related to university admissions during the pandemic for all individuals planning to proceed to higher education.

Study Limitations and Suggested Research Lines

Several limitations of the present study should be mentioned. While the data collected in this study offer, in our opinion, theoretically and practically valuable information on important stress appraisal and short-term outcome-related variables, a thorough understanding of the stress processes elicited by conditions of studying during the pandemic would require taking into consideration other psychological attributes proven to be relevant factors in individuals' responses and adaptation to stressful circumstances. These would include, for instance, certain personality dispositions, measures of cognitive efficacy, additional background and socio-environmental factors, and situation-specific coping mechanisms, along with measures of their effectiveness – that is, measures of the impact of these processes on short- and long-term educational, health, or other adaptation outcomes. Such a study would preferably seek longitudinal data as part of an adequate research design for testing hypotheses relating to stress and coping processes. Given the complex nature of the enduring COVID-19 pandemic, analyzing a role of other types of cognitive appraisals, and measures of perceived stressor controllability in particular, would be advantageous in clarifying the dynamics of school-related stress experiences and indices of wellbeing relationships during the course of the pandemic.

Practical Implications

The insights into students' experiences revealed in this study appear to be more or less directly applicable to educational practice; hence, they are probably useful in a broader context than that of the Croatian high-school system. First, different aspects of online schooling experiences appear to vary extensively in terms of reported stressfulness, suggesting that some features of the new teaching practices deserve more attention (e.g., the issue of the complexity and volume of weekly assignments that students are able to accomplish given the circumstances) than others (e.g., technical or communicational aspects) when planning alternative forms of teaching or upgrading existing ones.

Second, there are apparently large individual differences both with regard to the aspects of living or learning circumstances experienced by students as stressful, and in terms of the reported intensity of emotional and adjustment difficulties. These findings

suggest that attempts to implement interventions aimed at alleviating the adverse effects of the current crisis would only make sense if they are highly individualized and adjusted to the specific concerns of particular students.

Third, the fact that the highest levels of stress were reported by senior students suggests that situations of uncertainty due to lack of information provided by relevant policy makers on important issues, such as how the state graduation exams will be implemented in the new circumstances, are probably more serious stressors than all the actual changes in living and learning conditions. As briefly noted earlier in this paper, this study was designed following an initiative by the school authorities and the regional organizations of school psychologists, so the objectives of such an endeavor identified and declared by these bodies were clearly of a practical nature. Upon completion of the study, each school received an extensive report with their own results along with detailed overall study results pertaining to the total sample. Thus, the study results served as a basis for self-reflection among teaching staff and self-evaluation by schools participating in the study. All the insights and comparisons with other schools provided opportunities for the schools for more informed decision-making on necessary adjustments required given the global change in health circumstances.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

VB contributed to the conceptual design, literature research, data analysis, and writing of the manuscript. PB contributed to the conceptual design, data acquisition, data preprocessing and interpretation of results, and writing of the manuscript. Both authors contributed to the article and approved the submitted version.

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A Short, Multimodal Activity Break Incorporated Into the Learning Context During the Covid-19 Pandemic: Effects of Physical Activity and Positive Expressive Writing on University Students' Mental Health—Results and Recommendations From a Pilot Study

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Physical inactivity, sedentary behavior and mental ill health, due to high levels of perceived stress or self-reported depressive symptoms, are highly prevalent among university students. There are concerns that these behaviors and mental symptoms have significantly increased during the current Covid-19 pandemic, partly because academic life has changed considerably from face-to-face communication to e-learning and studying at home. Self-regulation and physical activity are hard to maintain during pandemic lockdowns. Short activity breaks could be helpful to avoid physical inactivity and sustain mental health. The breaks should comprise short and easy-implementable physical activity exercises that can be integrated into the learning context. Moreover, cognitive interventions, such as writing about positive events and feelings might help as coping strategy for self-regulation during study breaks. This study investigated and compared the effects of a physical activity intervention and a cognitive intervention (positive expressive writing) on mental health among university students. Both interventions are particularly suitable for use at home. $N = 20$ university students, studying in Germany, were assigned to a physical activity group or a cognitive intervention group. The physical activity intervention consisted of a mix of physical exercises including endurance exercises, muscular strength, relaxation, and ballroom dance movements. The interventions were carried out guided, once a week, for 5–10 mins at the beginning of classes. The effects of *group* × *time* showed no significant interaction on self-reported perceived stress, mood, quality of life (QoL) assessed online and compared at the beginning of the term before the intervention (T0) and at the end of

the term after the intervention (T3). However, the physical activity group reported a similar physical activity level per day over time, while the cognitive intervention group showed a decrease in physical activity from T0 to T3. Low-dose, short physical activity interventions as well as cognitive interventions consisting of positive expressive writing could buffer university students' perceived stress, mood, and QoL across the term. Moreover, both interventions seem to be promising in buffering the negative side effects of stress during the Covid-19 pandemic.

Keywords: Covid-19, physical inactivity, mental health, stress, university, physical activity program, positive expressive writing, cognitive intervention

INTRODUCTION

Maintenance of physical and mental health and well-being is associated with fundamental human needs across all age-groups. While bodily needs like nourishment or feelings of safety are innate, being physically active is part of human evolutionary heritage. Already during the first few hours of their life, newborns show signs of physical activity, e.g., crawling (Widström et al., 2011). Acting and "grasping the world through action, movement and physical activity" is part of a child's exploratory behavior and a necessary developmental means for brain and mental development as well. In fact, staying physically active and embodied is essential for healthy aging in general (Engeroff et al., 2018). Crucially, physical activity and feelings of safety are momentarily at risk due to the Coronavirus pandemic (Covid-19; Maugeri et al., 2020; Woods et al., 2020). Especially social distancing, caused by the pandemic societal lockdowns, is sought to lead to increased physical inactivity and mental ill health (Hall et al., 2020). Importantly, not only older age groups are affected, but the pandemic has an impact on physical activity across age groups, including those age groups, that might still be equipped with good mental and physical health (Hall et al., 2020). Therefore, it is mandatory to find psychological interventions that help people to continue to exercise, despite the demand of staying at home (Lippi et al., 2020; Woods et al., 2020).

Physical Health and Physical (In-)Activity During Covid-19

Physical activity can be understood as an umbrella term for any kind of physical movement through the contraction and relaxation of muscles that requires energy expenditure (Caspersen et al., 1985). Physical fitness is one important aspect and dimension of physical activity. It is related to health and the ability to carry out certain physical activities. Physical fitness is often divided into health-related fitness categories like cardiovascular fitness or flexibility and skill-related fitness like balance or coordination, respectively (Caspersen et al., 1985; Corbin et al., 2000). Generally, the term "exercise" should be distinguished from physical activity as a structured and planned form of physical activity (Caspersen et al., 1985). However, the terms are not consequently used or separated in the literature and instead are often used interchangeably. The positive impact of physical activity, and of physical activity or exercise interventions in particular, on health (mental and physical) is widely supported in the scientific literature. Relationships were found, e.g., between physical activity (physical fitness in particular) and rate of morbidity for certain diseases, like coronary heart disease, cardiovascular disease or cancer, but also for all-cause mortality (Blair et al., 2001; for an overview of possible underlying mechanisms, see Mikkelsen et al., 2017). Furthermore, life-style related diseases caused by overweight, obesity or high blood pressure are negatively related to global physical activity and physical fitness among different age groups (Hansen et al., 2013). In the midst of Covid-19, the risk for these diseases is likely to increase because of physical inactivity (Lippi et al., 2020). At the same time, physical activity might serve as a buffer against negative effects of Covid-19 on the central nervous system and associated mental diseases like depression, e.g., by anti-inflammatory processes and strengthening of the immune system (Woods et al., 2020).

Mental Health Benefits Through Physical Activity and Exercise

Not only physical but also mental health can be improved by physical activity. Generally, physical activity can predict a 2-year decrease in perceived stress (Rueggeberg et al., 2012). Psychological stress is widely distributed in societies. In a survey in Germany from the year 2016, 61% of participants reported to feel stressed, with prevalence rates increasing (Techniker Krankenkasse, 2016). Perceived stress was found to be associated with negative mental health outcomes, e.g., supporting the development of a major depression (Hammen, 2005). On top of that, stress is known to also increase the risk for developing psychophysiological/psychosomatic diseases concerning the cardiovascular, nervous, endocrine and the immune system (Cool and Zappetti, 2019). Therefore, fostering physical activity, especially among those societal groups most stressed (Rueggeberg et al., 2012), should be an important aim of health, not only in general, but particularly now during the current pandemic. Since Covid-19 is especially dangerous for people with a poor immune system (Woods et al., 2020), stress should definitely be reduced. A study by Wunsch et al. (2019) showed not only chronic exercise to be beneficial when being exposed to psychosocial stress. Positive effects were also observed after an acute bout of exercise. Mood also tended to improve after 10–30 mins of acute, but also chronic exercise, as shown in a review by Chan et al. (2019). A positive association was also found for physical activity and quality of life (QoL; Gill et al.,

2013). The examination of possible moderating variables, e.g., age, intensity, length, duration and dose of exercise or physical activity, for the aforementioned association between physical activity and health variables, yielded contradictory results (e.g., Bassett-Gunter et al., 2017, versus Campbell and Hausenblas, 2009; Chan et al., 2019). Nevertheless, positive outcomes on mental health were found for varying types of sports. Chekroud et al. (2018) found a reduction in mental health burden in a cross-sectional longitudinal study with more than one million participants in the US for different types of sports, among them aerobic and anaerobic exercise, but also mindfulness exercise, that builds on the relation between body and mind (e.g., yoga or tai chi), compared to participants practicing no regular exercise or receiving no physical activity or exercise intervention. More specifically, improvements in health variables like mood, anxiety or depression could be achieved likewise through aerobic and anaerobic exercise in clinical as well as in subclinical populations (Martinsen et al., 1989a,b; for an overview, see Mikkelsen et al., 2017). Whether an additive effect of aerobic and anaerobic exercise types can be obtained, e.g., through the combination of endurance, strength, relaxation and coordination training, especially in subclinical populations, remains yet to be determined.

Recommendations on Physical Activity to Avoid Physical Inactivity During Covid-19

Concerning reports and nation-wide surveys before the Covid-19 pandemic, only 30% of the population, as stated in a study about physical activity in Germany (Techniker Krankenkasse, 2016), reported to meet the physical activity recommendations by the World Health Organization (World Health Organization, 2010). In Spain, a large survey with more than 2000 participants found the rate to meeting these guidelines to have lowered by as much as 12% due to Covid-19 confinement (López-Bueno et al., 2020). Generally, levels of physical inactivity seem to be on the rise (World Health Organization, 2010). Following WHO's guidelines, adults aged 18–64 years should do at least 150 mins of moderate-intensity physical activity (e.g., housework or dancing), or alternatively 75 mins of vigorous-intensity physical activity (e.g., running or fast cycling) per week (World Health Organization, 2010). As the fourth leading case for mortality (Kohl et al., 2012), physical inactivity is a concern that has to be addressed. Distinctive to physical inactivity is a sedentary lifestyle (Tremblay et al., 2010). More than 20% of people in Germany reported to sit more than 9 h per day (Techniker Krankenkasse, 2016). Generally, people in high-income countries sit between 8 and 10 h per day on average, according to ambulatory assessment based on accelerometer-estimates (Dempsey et al., 2014). A highly sedentary lifestyle can have deleterious health effects on physical health, specifically on a person's metabolism (Tremblay et al., 2010). Moreover, sedentary behavior and anxiety, depression and well-being are correlated (Gibson et al., 2017). There is evidence, that negative effects of sedentarism on mental health can be buffered by an appropriate amount of vigorous-intensity physical activity (Gerber et al., 2014). Since this high intensity cannot be reached or attained by all people, especially with stay-at-home orders during Covid-19, this strikes the question, whether a health-buffer effect can be maintained by regular exercises whose intensity and duration per session are below the typical range of moderate to high intensity workout, i.e. so called "physical activity breaks". These low intensity exercises might include aerobic and anaerobic exercises but their frequency per session does never exceed the daily activity level and heart rate stays at a level below 70% of the VO_2max (Centers for Disease Control, 2008, https://www.cdc.gov). Considering the duration of physical activity, there is consensus in the literature, that also short bouts of moderate-intensity exercise (<10 mins) can already be beneficial, especially for mental health, contributing to temporary mood improvements (for an overview see Powell et al., 2019). In times of the Covid-19 pandemic, short activity breaks of low- to moderate intensity, comprising different types of exercise, that do not need much financial effort, space and time, are especially helpful (Woods et al., 2020), especially also for people without any exercise experience.

Physical (In-)Activity and Stress Among University Students

The Covid-19 pandemic led to the isolation of many university students worldwide, with the universities having closed down completely and most lectures and seminars only presented online. Already a couple of years ago, a review by Irwin (2004) stated, that only half of university students do meet the physical activity guidelines by the American College of Sports Medicine (American College of Sports Medicine, 2000). The guidelines of the ACSM are comparable to those of the World Health Organization (2010). These guidelines are supported by only 26.7% of German university students having reported to carry out physical activity for more than 2.5 h per week, which is less compared to age associated norms outside the university context (Grützmacher et al., 2017). It can be expected that this number is even higher now because of Covid-19. On top of that, the same survey found 25.3% of students to report high levels of perceived stress and fatigue. Among these students, about one out of six showed symptoms of depression and anxiety. Stressors in this target group are particularly time and performance pressure (Grobe et al., 2018), a high workload and anxiety about the future (Jadoon et al., 2010). This has recently been supported in an RCT study among German university students (Herbert et al., 2020b). In this RCT, 19.61% of the students were found to report mild to severe depressive symptoms and they reported to sit for about 7.45 h per day on average (Herbert et al., 2020b).

In order to intervene against the aforementioned negative adverse side effects of the pandemic on physical and mental health, appropriate interventions are mandatory, especially among university students. Findings from several studies support the notion that different kinds of interventions, comprising physical components, could be beneficial, among them e.g., physical activity interventions (e.g., Baghurst and Kelley, 2014) or mindfulness based (exercise) interventions (e.g., for an overview, see Regehr et al., 2013; Galante et al., 2018). The physical and mental beneficial effects of endurance and

strength exercises are well-known and supported scientifically (Kramer, 2020). Relaxation methods, e.g., qigong or Progressive Muscle Relaxation (PMR) by Jacobson (1938), showed to be beneficial regarding perceived stress, relaxation, self-acceptance and anxiety in students (Sancier and Holman, 2004; Chrisman et al., 2009; Dolbier and Rush, 2012; Hubbard and Blyler, 2016). Additionally, pure cognitive interventions, based on stress diaries or on expressive writing, could also be a promising approach (Baikie et al., 2012; Pennebaker, 2018). These cognitive interventions have shown robust effects in previous studies in clinical groups (Krpan et al., 2013). Expressive writing has been used as a successful intervention in health psychology among different age and health groups (Frisina et al., 2004, for an overview). Typically, according to standard writing protocols (Pennebaker and Beall, 1986), participants are asked to write about their most stressful negative life events repeatedly in several sessions for about 15 mins a day. Findings converge, that after four sessions, significant health benefits can be found (Pennebaker and Chung, 2007). Cognitive interventions, such as expressive writing tasks, in which participants are asked to write expressively about negative life events, have been reported to improve stress- or emotion regulation and were used in studies with university students (e.g., Sloan et al., 2008; Park et al., 2014; Herbert et al., 2019). Interestingly, also expressive writing about positive events has recently been investigated as a means of positive emotion expression technique in both depressive patients and healthy controls (including university students) (see e.g., Herbert et al., 2019). In the study by Herbert et al. (2019), one session of writing about positive autobiographical events already led to positive effects both on self-reported mood and self-reported bodily symptoms immediately after the writing session (e.g., Herbert et al., 2019). The broaden-and-build theory of positive emotion by Fredrickson (1998) might explain this effect, suggesting that positive writing might lead to a deeper cognitive and emotional processing, which in turn is associated with a heightened attention toward one's needs, creativity and well-being (Fredrickson, 1998; Burton and King, 2004).

Health interventions for university students are mandatory, even more since the Covid-19 pandemic hinders them to carry out their regular exercises. These interventions should adapt to university students' needs as being time-efficient, low-cost, and most suitably directly integrable into the university students' learning routine to strengthen adherence and exercise (Herbert et al., 2020a). On top of that, exercises should be space-saving to be carried out at home with an appropriate level of difficulty (Herbert et al., 2020a). Building upon the previous literature, the present study aimed to find out, whether a program, built upon different physical activity components, e.g., consisting of endurance and strength exercises, but also including mindfulness exercises and also so far not well scientifically examined activities like ballroom dance, could have the same or even an additive effect on mental health of students. Positive effects of dance on stress and depressive symptoms (López-Rodríguez et al., 2017) were already reported in the literature. Dance has also been recommended as a physical activity during the current Covid-19 pandemic by health experts (Hammami et al., 2020), due to its beneficial effects on body and mind. Nevertheless, scientific investigation of effects of ballroom dance on mental health and well-being is underrepresented in the literature. Since ballroom dance steps can be learned and also carried out without a partner, learning dance steps of dances like Discofox or Salsa could be feasible at home, requiring only little space. Furthermore, dancing can be fun (Lima and Vieira, 2007), while at the same time fostering enjoyment and associated adherence (Wankel, 1993; Ryan et al., 1997; Hammami et al., 2020). Similarly, cognitive interventions based on expressive writing, focusing on positive emotion expression, could be particularly useful as an emotion regulation strategy among university students, who have little experience with exercise programs or are anxious to perform on their own. So far, combined interventions, comprising exercise and cognitive interventions, indicate to be promising with regard to variables like perceived stress, depressive symptoms, anxiety or mood (for e.g., see Deckro et al., 2010; de Bruin et al., 2017). However, studies that compare the effects of physical exercise interventions against cognitive interventions like positive expressive writing are still scarce (e.g., see for an overview Herbert et al., 2020b). Such comparisons would allow for an estimation of the advantage and relative effects of physical exercise interventions over cognitive interventions and vice versa among populations at risk of stress-related and mental disorders.

Aims of the Present Pilot Study: Physical Activity Breaks vs. Cognitive Breaks

The aim of this study was to investigate the effects of a multimodal physical activity intervention on mental health and well-being of university students and to compare the effects with a cognitive intervention, consisting of expressive writing about positive autobiographical events. Crucially, as outlined in the Introduction, the focus was on investigating "activity breaks", consisting of physical exercises of short duration versus cognitive interventions (writing about positive events), that also allow easy implementation within the daily working schedule of university students. The term "physical activity intervention" was chosen instead of "exercise intervention" because (a) the "activity breaks" comprised different exercise types (described in detail below) and (b) the effects of the two interventions (physical activity versus writing) on physical fitness were investigated with assessment tools, that determined global physical activity behavior (and not necessarily exercise behavior) before and after the interventions. The interventions were directly embedded in the student's learning context. Hence, they were carried out in the classroom and supervised by an exercise professional. The study was carried out before the Covid-19 pandemic across one term (approximately 6 months). Thus, the results are not influenced by the current pandemic situation. Therefore, they can lead to recommendations for beneficial health interventions during the Covid-19 pandemic, based on the regular demands of university students. Moreover, as mentioned above, the focus of our interventions was on low frequency interventions (once a week), whose durations are considered short (∼10 mins) and are therefore excellently suited to be performed at home. The different exercises included in the physical activity program

require little effort to be carried out on a daily basis in between learning units, irrespective of whether performed at home or in the (virtual) classroom. Concerning the intensity and duration of the investigated physical activity interventions, no physiological adaptations can be expected from the low dose of the interventions according to the previous literature. Thus, in case mental health effects can still be detected, these effects are to be interpreted as due to low dose effects. Moreover, this would suggest, that a mix of low-intensity endurance and muscular strength exercises, mindfulness exercises and exercises related to ballroom dance steps could stimulate the body and the mind by integrating physical and (neuro-)cognitive functions and well-being. Moreover, the physical activity breaks should trigger and increase participants' awareness of generally being more physically active in everyday life.

Similarly, the cognitive intervention of positive expressive writing is expected to have positive effects on university students' mental health, including perceived stress and mood, respectively (e.g., Herbert et al., 2019). Differential effects on mood and stress perception between the two interventions might occur on a weekly basis, but are not primarily expected at T3 (at the end of the interventions). In summary, it is expected, that both interventions will buffer the typical increase of stress and negative mood across the term, associated with the accumulation of cognitive work load from the beginning to the end of term (e.g., Pitt et al., 2018). These questions, concerning the effects of two short interventions on mental health, are addressed in the current study by the assessment of mental health variables, including perceived stress, positive and negative mood, body image, QoL and changes in physical activity or sedentary behavior before and after the participation in the interventions. Of note, it is expected, that these effects hold true for women and men, although in the present study, the final sample consisted of an all-female sample only and comprised a small sample size. This needs to be taken into consideration when talking about the generalizability of the results. However, the two interventions were not developed nor designed for usage of a specific gender, and the aforementioned mental health dimensions were measured via standardized self-report questionnaires (outlined in detail below under section Procedure and study design). This allows comparisons with population norms, despite small sample sizes or a gender bias.

MATERIALS AND METHODS

Participants

Participants were recruited via oral presentation of the study at the beginning of four preselected seminar courses that took place during the winter term 2018/19. The courses were offered by the Department of Applied Emotion and Motivation Psychology at Ulm University. Participation was voluntary and students could opt out whenever they wished. The intervention was introduced and offered by an independent experimenter in four bachelor and master psychology courses. Exclusion criteria for participation were clearly defined, and included an age below 18 years and pre-existing conditions of any physical impairment (e.g., cardiovascular disease or respiratory diseases), hindering the participation in low- to moderate-intensity exercise. Although gender was not an exclusion criterium, due to the gender bias in the courses, only three male students could be recruited as participants and of these, one had missing data. Participants were pre-selected for participation in one of the intervention groups (physical activity versus cognitive intervention group) and care was taken, that the two groups had comparable sample sizes. Two of the university classes were chosen to take part in the (physical) activity intervention group (PAG) and two classes were asked to take part in the cognitive intervention group (CG). Data collection was anonymous and blind for the lecturer of the courses to avoid any bias between the courses and interventions. Among all participants, 10 × 20€ vouchers for *Amazon* were raffled. Alternatively, bachelor students were granted 3.75 h of participation as part of their bachelor student curriculum.

Prior to the start of the interventions (T0), participants received a link to an online questionnaire that they filled out from home, 1–7 days before the start of interventions. In addition, the online questionnaire was repeated at four different time points during the intervention period (T1 and T2), at the end of the intervention period (T3) and at follow-up 6 weeks after the last session (T4). Dropout numbers, participation numbers and numbers of analysis can be found in **Figure 1**. In total, $N = 56$ (PAG: $n = 32$; CG: $n = 24$) participants took part in the first online measurement (baseline, T0). For the per-protocol analysis, only participants having provided data at baseline measurement (T0) and at the end of the term (T3) were taken into account. These two points of time were chosen for the current paper in order to focus on the change in mental health and activity during one semester. Dropout rate from baseline measurement T0 to T3 was 52.17% (PAG: 39.13%; CG: 65.22%). There was no significant relation between group membership and dropout, $\chi^2(1) = 3.14$, $p = 0.077$, with odds of dropping out having been 0.35 (0.09, 1.32). Finally, an all-female sample was examined. $N = 20$ participants (PAG: $n = 13$; CG: $n = 7$) were analyzed for the comparison between T0 and T3. Sensitivity power analysis in Gpower (Faul et al., 2009) revealed that an effect size of $f = 0.33$ would be required given a Type I error probability of 0.05 and a power of 0.80 with this sample size for between/within comparison.

Procedure and Study Design

In order to ensure comparable sample sizes, a quasi-experimental design without randomization was chosen. The duration of the individual intervention sessions was 5–10 mins for both groups. The interventions took place every week during the term right at the beginning of the seminar course. The different times of measurement (baseline T0, T1 and T2 during the semester, T3 at the end of term and follow-up T4) were examined to control for differential effects of the two interventions across the intervention period and to determine possible carry-over effects of the intervention from T3 (end of the intervention) to follow-up T4, although T0 to T3 comparisons can be considered to be the most robust comparisons and are the main focus of comparisons reported in section Results of the manuscript. At T0, participants completed a test of selective attention (*d2-R Test for Attention*; Brickenkamp et al., 2010) as paper-pencil version on site at university. They also received a link to the online questionnaire, which they had to fill in at home during the week

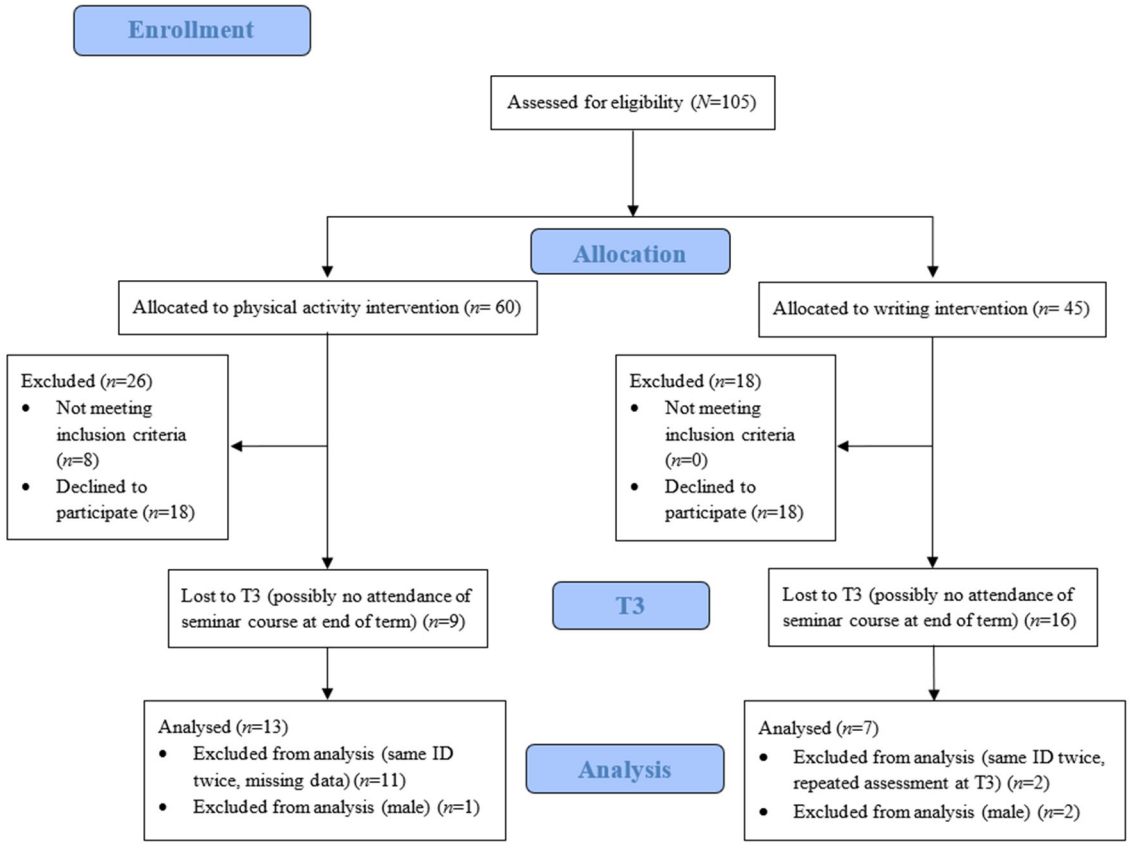

FIGURE 1 | CONSORT diagram depicting dropout numbers, participation numbers and numbers of analysis in the online questionnaire.

of T0 (baseline), before the start of the interventions. In 3-week intervals, at T1, T2 and T3, the online questionnaire was repeated and again administered at T4. The T4 follow-up measurement took place online during the semester break, 6 weeks after the last intervention. Participants received one email before each time of measurement, reminding them about filling out the online questionnaires. The online questionnaires were construed with *Unipark* software (Questback GmbH, 2016).

Measures/Self-Report Questionnaires

All health dimensions of the online questionnaire were assessed via standardized questionnaires. The *Perceived Stress Scale-10* (PSS-10; Cohen et al., 1983) and the *Stress and Coping Inventory* (SCI; Satow, 2012) were used as psychological measures of perceived stress. The PSS-10 (Cohen et al., 1983) is a standardized 10-item scale. Items (e. g. "In the last month, how often have you found that you could not cope with all the things that you had to do?") are rated on a 5-point Likert-type scale ranging from 0 to 4. Higher scores depict higher perceived stress. The SCI (Satow, 2012) contains ten subscales. A sum score for overall burden with psychological stress was analyzed (21 items; made up of the subscales stress due to uncertainty, stress due to excessive demands and stress due to loss). Every single subscale ranges from 1 to 7 (higher scores equal higher perceived stress). On top of that, the subscale physical and mental stress symptoms (13 items; e. g. "I often suffer from a headache") was used.

The *World Health Organization-Quality of Life-BREF* (WHOQOL-BREF; The WHOQOL Group, 1998) was administered to measure QoL across certain life domains (physical and psychological health, social relationships and environment). Physical and psychological health domains (13 items, e.g., "How satisfied are you with yourself?") were analyzed. Scores range from 1 to 5, with higher scores depicting higher QoL.

The *Positive and Negative Affect Schedule* (PANAS; Watson et al., 1988; German version by Krohne et al., 1996) was used to assess state and habitual positive and negative affect. Twenty positive and negative adjectives (e. g. strong or scared) have to be rated on a 5-point Likert-type scale varying from 1 to 5, with higher scores showing higher affective state or trait affect.

The *Global Physical Activity Questionnaire* (GPAQ; Armstrong and Bull, 2006) was used to determine global physical activity levels of the participants prior to the start of the interventions and at the end of interventions. The GPAQ (Armstrong and Bull, 2006) asks for regular physical activity of moderate and vigorous intensity at work, during travel to and from places and activity as recreational activities. It also

measures sitting time (sedentary time) in hours and minutes per week. Physical activity per day can be obtained including the three domains at work, travel to and from places and recreational activity.

To determine risk of depression, the *Beck Depression Inventory-II* (BDI-II; Beck et al., 1996; German version by Hautzinger et al., 2006) was administered. It consists of 21 items (e.g., "I am so sad or unhappy that I can't stand it") and is measured on a Likert-type scale with a range from 0 to 4 (higher scores corresponding to higher depressive symptomatology).

The *Eating Disorder Inventory-2* (EDI-2; Garner, 1991; German version by Thiel et al., 1997) measures cognitive and behavioral dimensions of eating disorders. It comprises eleven subscales. Only the subscale Body Dissatisfaction was used (8 items; e. g., "I think that my thighs are too large"). Higher scores equal higher body dissatisfaction.

Moreover, the *Physical Activity Readiness Questionnaire* (PAR-Q; Shepard, 1988) was included for the assessment of possible health restrictions, preventing participation in the physical activity program in the physical activity group. Seven possible health restrictions were queried. One of these items (dizziness) was left out because the discriminatory power is doubted. In case one of the six remaining items was answered with yes (e.g., "Do you feel pain in your chest when you perform physical activity?"), the participant was excluded directly from the questionnaire. The PAR-Q (Shepard, 1988) was only used for the PAG because the CG did not carry out any physical activity.

The *Balanced Inventory of Desirable Responding* (BIDR; Paulhus, 1988; German version by Musch et al., 2002) was used in order to control for the tendency of answering with social responding. Only the subscale Impression management (10 items; e.g., "I never swear") was administered. It can be rated on a scale ranging from 1 to 7, with lower scores depicting a higher social desirability tendency.

The *Reasons for Exercise Inventory* (REI; Silberstein et al., 1988) was administered to assess participants' previous exercise motivation and reasons for exercising. It is a 24-item scale measuring seven different reasons to work out (Mood, Fitness, Health, Enjoyment, Weight Control, Tone, Attractiveness; sample item: "To have fun"). Participants rate these dimensions on a scale from 1 to 7. Higher scores support the consent on a particular reason for exercise. The results of the REI can be found in the **Supplementary Material** of this manuscript.

Selective attention was measured directly on-site during courses via the *d2-R Test for Attention* (Brickenkamp et al., 2010) as paper-pencil version. The d2-R is a standardized cognitive measurement. Certain letters on several rows have to be crossed out, while others have to be left out. Speed and accuracy are most important. The factor ability to concentrate was used for the current study. The results of the d2-R (Brickenkamp et al., 2010) can be found in the **Supplementary Material** of this manuscript.

The PANAS state (Watson et al., 1988; Krohne et al., 1996) as well as the GPAQ (Armstrong and Bull, 2006) and the PSS-10 (Cohen et al., 1983) were assessed at all measurement times to control for differential intervention effects on mood and stress across the duration of the two interventions (physical activity versus positive expressive writing). The self-report questionnaire at T2 additionally contained the WHOQOL-BREF (The WHOQOL Group, 1998) for QoL. Primary and secondary variables were again assessed completely at T3 and at follow-up (T4). The d2-R (Brickenkamp et al., 2010) was applied at all times of measurement during the term (at T0, T1, T2 and T3). Results concerning the d2-R (Brickenkamp et al., 2010) and reasons for exercise (REI; Silberstein et al., 1988) can be examined in the **Supplemental Material** for a subset of the participants.

The cognitive intervention was also analyzed descriptively for its content, i.e. number of words, and the semantic and emotional categories they belong to were analyzed by using the Linguistic Inquiry Word Count (LIWC; Pennebaker et al., 2001; http://liwc.wpengine.com) tool. The LIWC (Pennebaker et al., 2001) is a quantitative text analysis program, counting and categorizing words by predetermined content (e.g., emotional content, social contents, function words, self-referential content words, etc.).

Interventions

(Physical) Activity Intervention

The physical activity group received weekly physical activity breaks provided by the authors. The physical activity breaks followed standardized exercise protocols and physical activity guidelines (see **Figure 2** for an overview). As shown in **Figure 2**, the individual exercises of the physical activity break comprised different components: aerobic endurance and muscular strength exercises, relaxation and dance steps (see **Figure 2** for example exercises). All of the exercises are suitable to be done with limited space, at home or during e-learning, either in a standing position or seated on a chair. Each component was carried out 3 weeks in a row in the specified order. The exercises were guided by an exercise model, hence the possibility for correction and motivation enhancement was given in order to improve adherence. Participants were instructed to carry out the exercises according to the exercise model, who always stood in the front of the room, facing the students. The exercise model gave instructions for each exercise, e.g., in terms of proper posture and execution.

Cognitive Intervention

The cognitive intervention also followed standardized protocols. It comprised a positive expressive writing task, developed by the corresponding author and used in previous studies (e.g., Herbert et al., 2019). The instructions of the positive expressive writing task were adapted from the original expressive writing protocol, provided by Pennebaker and colleagues (e.g., Pennebaker, 2018). Accordingly, participants were asked to write about own feelings without focusing on spelling or grammar. However, in contrast to the typical expressive writing conditions, asking to write about traumatizing negative live events across repeated sessions, in the present study, the participants were asked to expressively write about positive autobiographical life events only. They were free to write about any personal positive experiences that came to mind. The writing task was carried out as paper-pencil task. The cognitive intervention group was matched to the physical activity group (e.g., with regard to duration of

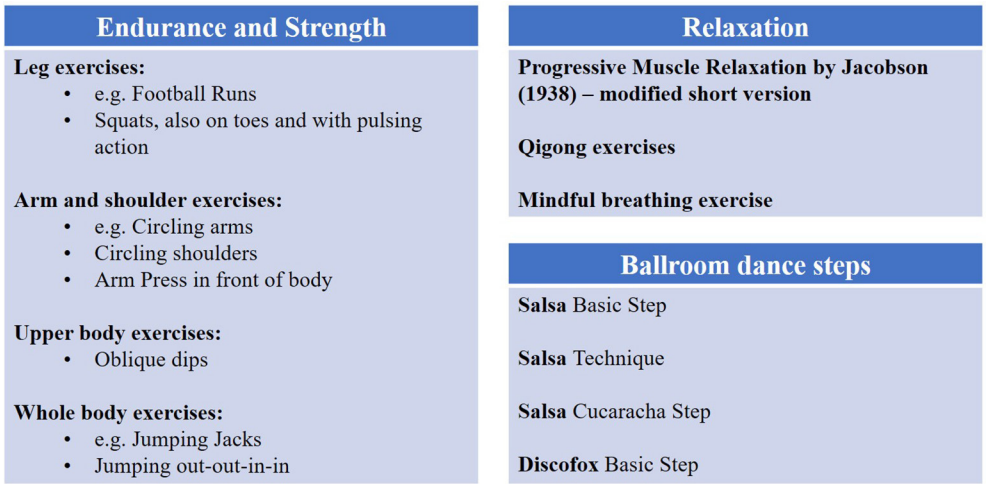

FIGURE 2 | Selection of exercises as part of the physical activity program. Muscular and endurance exercises were based on and adapted of the fitness program *Blogilates* by Cassey Ho (www.blogilates.com), inspired by high-intensity interval training with each exercise being carried out for 1–2 mins with short breaks of 10–15 s in between. Relaxation sessions consisted of a modified version of Progressive Muscle Relaxation (PMR; Jacobson, 1938), qigong exercises and a mindful breathing exercise developed by Department of Applied Emotion and Motivation Psychology of Ulm University. Ballroom dance steps were taught by a certified dance teacher according to the guidelines by the *Allgemeiner Deutscher Tanzlehrerverband e.V. (ADTV)*. The steps were carried out without a partner. Progressive Muscle Relaxation-modified short version by Department of Applied Emotion and Motivation Psychology of Ulm University, originally by Jacobson (1938).

the sessions of the intervention, the setting and guidance by an instructor).

Data Analysis and Statistics

The statistical analysis was carried out with the statistics program *RStudio* (Version 1.2.5033; R Studio Team, 2019). In order to find possible differences in dropout rate, Pearson's chi square test was used. Possible group differences concerning continuous variables, i.e. age, depression, body dissatisfaction, etc., were examined via linear regression with the factor *group*. In case the assumptions of linear regression were violated, a bootstrapping procedure following Field et al. (2012, pp. 298–301) was used. For the main analyses, data were filtered in order to leave only participants with T0 and T3 measurements, hence following per-protocol analysis. Group comparisons over time (*group* × *time* interactions) were calculated via linear mixed-effects models with the R package *nlme* (Pinheiro et al., 2019). *Group* and *time* were dummy-coded. Variables age, depression and degree were included in the models if there was a significant difference between groups in order to control for these differences. Effect size *r* was chosen, as recommended by Field et al. (2012, pp. 640–641). In case of violation of assumptions for the models, a two-way between-within subjects analysis of variance (ANOVA) of trimmed means (20%), as developed by Wilcox (2017) was carried out, included in the *WRS2* package (Mair and Wilcox, 2020). Unfortunately, the *bwtrim* function of this package only computes a two-way between-within subjects ANOVA on trimmed means designed for one between-subjects and one within-subjects variable. Hence, the inclusion of further variables, e.g., depression or age as control variables, is not possible with this package. The *p*-value for significance was set to $p \leq 0.05$.

RESULTS

Statistics of the Two Groups Before the Start of the Intervention (T0)

As can be seen in **Table 1**, the cognitive intervention group had a higher mean age ($M = 24.14$, $SD = 0.90$) than the physical activity group ($M = 22.39$, $SD = 2.02$). This difference was significant, $B = -1.76$, $SE_B = 0.81$, $t(18) = -2.17$, $p < 0.05$. Pursued university degree differed between the two groups, with the PAG having consisted of more bachelor than master students than the CG (see **Table 1**). In the cognitive intervention group, the majority of students pursued a master degree. The distribution was significantly different between groups, $\chi^2(1) = 5.80$, $p < 0.05$. Across groups, the majority of students (35.00%) reported to spend 5–10 h per week at university to perform classes, courses and lectures, followed by 30.00% of students, who reported to spend 10–15 h per week at university for learning activities (teaching). 25.00% reported to attend lectures for 15–20 h per week, while 10.00% had a higher attendance time of more than 25 h per week. None of the student participants spent < 5 h per week at university.

At T0 (baseline measurement), the cognitive intervention group had a higher mean depression score compared to the physical activity group on the Beck Depression Inventory-II (BDI-II; Beck et al., 1996; German version by Hautzinger et al., 2006). There was a significant difference between groups, 95% CI [−13.68, −1.60]. According to the cut-off scores of the BDI, the PAG can be categorized as a non-depressive sample ($M = 3.85$, $SD = 3.65$, *range* = 0–11), while the cognitive intervention group had a mean score classified as minimal depression ($M = 10.14$, $SD = 7.63$, *range* = 3–23). Body dissatisfaction, as indicator

TABLE 1 | Baseline self-report data of participants in dependence of group with means and standard deviations.

	Group	
	Physical activity group	**Cognitive intervention group**
Sample size	13	7
Mean age	22.39 (2.02)	24.14 (0.90)
Pursued university degree	7 Bachelor degree 6 Master degree	0 Bachelor degree 7 Master degree
Mean university activity per week at home (in hours)	18.31 (9.80)	16.00 (9.88)
BDI-II (depression)	3.85 (3.65)	10.14 (7.63)
EDI-2 (body dissatisfaction)	29.77 (7.97)	26.86 (7.24)
GPAQ (total physical activity per day in minutes)	62.86 (48.99)	137.96 (148.64)
GPAQ (sedentary time per day in minutes)	574.62 (197.43)	638.57 (346.72)

Data from online-questionnaire. University activity encompasses attendance time and activities at home. The following questionnaires and scales were used: Beck Depression Inventory-II (BDI-II; Beck et al., 1996; German version by Hautzinger et al., 2006), Eating Disorder Inventory-2 (EDI-2; Garner, 1991; German version by Thiel et al., 1997), Global Physical Activity Questionnaire (GPAQ; Armstrong and Bull, 2006).

for eating disorders in the Eating Disorder Inventory-2 (EDI-2; Garner, 1991; German version by Thiel et al., 1997), at baseline measurement (see **Table 1**) can be categorized as unobtrusive (score below 35.6 as cut-off score in a validation sample of anorexia nervosa patients; Paul and Thiel, 2005). Although the PAG had higher body dissatisfaction scores, there was no significant difference between groups, $B = 2.91$, $SE_B = 3.63$, $t(18) = 0.80$, $p = 0.432$. At T0 (baseline), 15.00% of participants did not meet the recommendations of physical activity for health as stated by the World Health Organization (World Health Organization, 2010). Physical activity per day, measured with the Global Physical Activity Questionnaire (GPAQ; Armstrong and Bull, 2006), was 89.14 mins on average ($SD = 99.21$). The CG reported approximately double the amount of physical activity compared to the PAG at T0, although there was no significant difference between groups, 95% CI [−233.34, 6.19]. Sedentary time per day was 597.00 mins on average (=9.95 h per day; $SD = 252.11$ mins). Both groups were comparable in sedentary time, 95% CI [−470.94, 125.88]. Participants were asked about the number of sessions they attended during the last 3 weeks. On average, they attended 1.80 sessions ($SD = 0.70$). Number of participation was equal among both groups (PAG: $M = 1.85$, $SD = 0.80$; CG: $M = 1.71$, $SD = 0.49$), 95% CI [−0.40, 0.70].

Comparisons Between Intervention Groups Over Time (T0 vs. T3)

Descriptive statistics for times of measurement T0 with T3 are depicted in **Table 2**. Perceived stress, measured via the PSS (Cohen et al., 1983), was higher for the cognitive intervention group than for the physical activity group independent from time of measurement, with a significant main effect for *group*, $Q = 6.77$, $p < 0.05$. As expected (due to assessment phase at the end of term), stress levels were generally marginally higher at T3 compared to T0, although not significantly, $Q = 1.95$, $p = 0.203$. The *group* × *time* interaction was not significant, $Q = 0.04$, $p = 0.841$. The same as in the PSS (Cohen et al., 1983) for the factor *group* applied for overall stress burden and physical and mental stress symptoms of the SCI (Satow, 2012): The cognitive intervention group showed higher stress levels, although not significantly, overall stress burden: $Q = 3.26$, $p = 0.127$, stress symptoms: $Q = 1.63$, $p = 0.258$. Perceived stress was marginally lower at T3 compared to T0 for overall stress burden, $Q = 1.24$, $p = 0.313$, and stress symptoms decreased for the physical activity group, but increased for the cognitive intervention group, $Q = 0.01$, $p = 0.934$. The *group* × *time* interaction for both subscales was not significant, overall stress burden: $Q = 0.30$, $p = 0.607$, physical and mental stress symptoms: $Q = 0.09$, $p = 0.774$. Both main effects of *group* and *time* for positive state affect were not significant, *group:* $Q = 0.25$, $p = 0.640$, *time:* $Q = 0.41$, $p = 0.543$. This was also found for the interaction effect *group* × *time*, $Q = 0.19$, $p = 0.673$. Overall, the cognitive intervention group reported a higher negative state affect compared to the physical activity group, although this main effect of *group* was not significant, $Q = 3.98$, $p = 0.108$. Both the physical activity group and the cognitive intervention group reported a decrease in negative affect over time, however with the main effect of *time* having been not significant, $Q = 0.45$, $p = 0.536$. There was no significant interaction effect, $Q = 0.04$, $p = 0.841$.

Concerning physical activity per day, as can be seen in **Figure 3**, the cognitive intervention group showed a higher activity score at T0 than the physical activity group. While the activity score of the PAG increased slightly, the CG reported a much lower score compared to T0 and also lower compared to the activity group. This interaction *group* × *time* was significant, $B = 86.18$, $SE_B = 35.23$, $t(17) = 2.45$, $p < 0.05$, $r = 0.51$. Factors *group*, $B = -92.65$, $SE_B = 42.90$, $t(16) = -2.16$, $p < 0.05$, $r = 0.48$, and *time*, $B = -86.63$, $SE_B = 28.39$, $t(17) = -3.05$, $p < 0.01$, $r = 0.60$, also showed a significant effect. Differences between groups over time were especially seen for physical activity related to travel to and from places and vigorous, as well as moderate recreational activity per day (in minutes), as can be seen in **Table 3**. While the physical activity group showed no changes in physical activity while traveling or working out recreationally, traveling and especially vigorous recreational physical activity decreased for the cognitive intervention group. Moderate-intensity recreational activity increased for the CG, although unrelated to the high decrease in vigorous-intensity recreational activity for this group. All group and time effects for

TABLE 2 | Mean scores and standard deviations (SDs in brackets) of scales in dependence of time of measurement (online questionnaire: physical activity group with $n = 13$, cognitive intervention group with $n = 7$).

Questionnaires (range)	Time of measurement			
	T0 (Baseline)		T3	
	Physical activity group	Cognitive intervention group	Physical activity group	Cognitive intervention group
PSS-10 Perceived stress (0–40)	8.08 (3.20)	11.29 (4.39)	8.85 (3.21)	12.14 (2.91)
SCI				
Overall stress burden (21–147)	40.23 (11.27)	52.29 (19.33)	35.46 (7.83)	50.43 (15.14)
Physical and mental stress symptoms (1–4)	1.59 (0.35)	1.89 (0.62)	1.52 (0.21)	1.99 (0.79)
PANAS				
Positive state (1–5)	2.53 (0.84)	2.57 (0.75)	2.54 (0.57)	2.33 (0.36)
Negative state (1–5)	1.31 (0.36)	1.99 (0.90)	1.23 (0.25)	1.79 (0.46)
GPAQ				
Total physical activity per day in minutes	62.86 (48.99)	137.96 (148.64)	63.85 (44.92)	51.33 (42.98)
Sedentary time per day in minutes	574.62 (197.43)	638.57 (346.72)	588.46 (155.66)	608.57 (123.35)
WHOQOL-BREF				
Physical domain (4–20)	17.46 (0.88)	16.00 (2.08)	17.08 (1.04)	15.00 (1.83)
Psychological domain (4–20)	15.62 (1.33)	15.00 (3.22)	15.69 (1.97)	14.57 (2.30)

T3 measurement was taken at the end of semester. The following questionnaires/tests (and subscales) were used: Perceived Stress Scale-10 (PSS-10; Cohen et al., 1983), Stress and Coping Inventory (SCI; Satow, 2012), Positive and Negative Affect Scale (PANAS; German version by Watson et al., 1988; Krohne et al., 1996), Global Physical Activity Questionnaire (GPAQ; Armstrong and Bull, 2006), and World Health Organization-Quality of Life-BREF (WHOQOL-BREF; The WHOQOL Group, 1998).

the subscales were not significant, all $ps > 0.05$. The same was found for the interaction effects of the subscales (vigorous work activity per day: $B = -0.87$, $SE_B = 13.06$, $t(17) = -0.07$, $p = 0.947$; moderate work activity per day: $Q = 0.47$, $p = 0.321$; travel to and from places: $B = 19.14$, $SE_B = 9.81$, $t(17) = 1.95$, $p = 0.068$; vigorous recreational activity: $B = 105.86$, $SE_B = 65.39$, $t(17) = 1.62$, $p = 0.124$; moderate recreational activity: $Q = 0.45$, $p = 0.533$).

Sedentary time was higher for the cognitive intervention group compared to the physical activity group. It increased for the PAG from T0 to T3, but decreased for the CG from T0 to T3. Both main effects were not significant, *group:* $Q = 0.01$, $p = 0.911$, *time:* $Q = 1.26$, $p = 0.306$, as was the interaction effect, $Q = 0.46$, $p = 0.524$. The physical activity group showed a higher QoL score for the physical domain and the psychological domain of the WHOQOL-BREF (The WHOQOL Group, 1998) compared to the cognitive intervention group, although this group effect was not significant, physical domain: $Q = 5.54$, $p = 0.070$, psychological domain: $Q = 0.52$, $p = 0.503$. The physical score decreased for both groups from T0 to T3, $Q = 6.58$, $p < 0.05$. The psychological score remained unchanged for the activity group and decreased marginally for the cognitive intervention group, $Q = 0.35$, $p = 0.573$. There was no significant interaction effect of *group* × *time* for both domains, physical domain: $Q = 3.11$, $p = 0.118$, psychological domain: $Q = 0.35$, $p = 0.573$.

Word Use: Descriptive Data Analytics as Manipulation Check

As expected, positive writing was characterized by a higher use of positive emotion words ($M = 6.30$) than negative emotion words ($M = 0.80$) across the weekly sessions. Use of discrete negative emotion words related to anger ($M = 0$), sadness ($M = 0.53$) or fear ($M = 0.13\%$) was negligible and almost not present. Authenticity ($M = 74$) of the writing as well as the tone ($M = 83.57$) of the writing were well pronounced, suggesting that writings were emotional, personal and self-revealing in all sessions. A high number of words was categorized into the "social" category of the LIWC dictionary (Pennebaker et al., 2001) and content of writing seemed to be equally distributed about work ($M = 2.02$) and leisure ($M = 2.64$), followed by home ($M = 1.23$), while categories related to death ($M = 0.02$) and money ($M = 0.30$) were underrepresented. Similarly, writing was characterized by present tense ($M = 7.65$) rather than past ($M = 4.85$) or future ($M = 0.51$) tense.

DISCUSSION

The purpose of the study was to compare the effects of two interventions, consisting of short activity breaks, one of them being a physical activity break and the other one being a cognitive intervention of positive expressive writing. These were compared with regard to their potential to alleviate mental health (perceived stress, positive and negative affect, QoL) and to improve habitual physical activity among university students across the university term. The physical activity intervention comprised a multimodal physical activity break of a duration of 5–10 mins, including endurance, strength, relaxation and dance exercises. The cognitive intervention consisted of an expressive writing task about positive autobiographical events. Both interventions were developed by the authors and followed a standardized in-house protocol. The interventions were carried out and guided once a week at the beginning of a weekly class

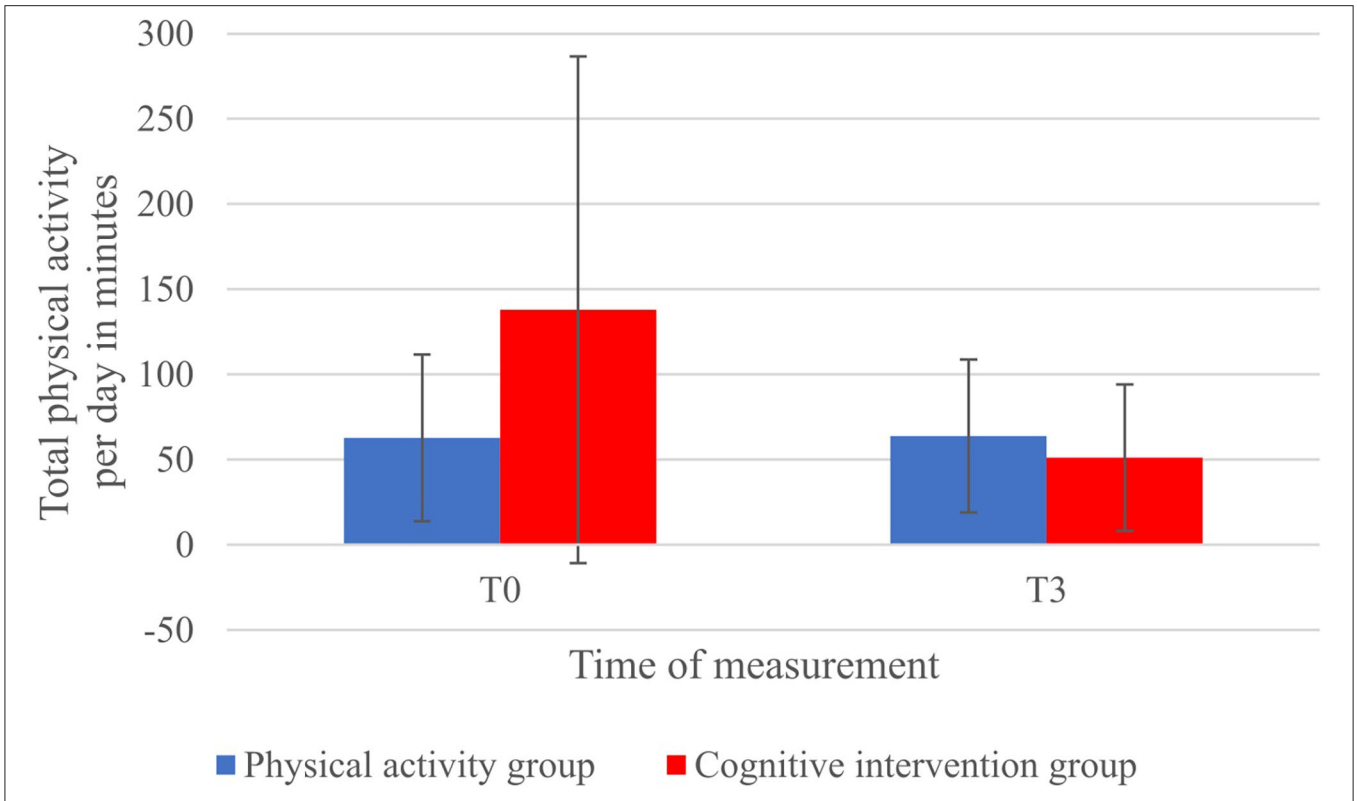

FIGURE 3 | Changes in mean total physical activity per day in minutes as measured by the *Global Physical Activity Questionnaire* (GPAQ; Armstrong and Bull, 2006) from T0 (baseline measurement) to T3 (end of semester) in dependence of group. Figure shows significant *group* × *time* interaction. Error bars depict standard deviations. $p < 0.05$.

TABLE 3 | Mean scores and standard deviations (SDs in brackets) of Global Physical Activity Questionnaire subscales in dependence of time of measurement and groups.

Subscale	Time of measurement			
	T0 (Baseline)		T3	
	Physical activity group	Cognitive intervention group	Physical activity group	Cognitive intervention group
GPAQ				
Vigorous work activity per day in minutes	1.15 (4.16)	0.00 (0.00)	9.23 (33.28)	8.57 (22.68)
Moderate work activity per day in minutes	16.92 (28.69)	34.29 (58.56)	20.00 (30.21)	24.29 (43.92)
Travel to and from places per day in minutes	29.62 (22.86)	47.14 (41.92)	29.23 (28.93)	27.86 (19.55)
Vigorous recreational activity per day in minutes	53.46 (52.26)	115.71 (219.38)	58.85 (47.62)	12.86 (34.02)
Moderate recreational activity per day in minutes	42.69 (38.71)	22.86 (33.02)	46.54 (54.37)	45.71 (55.03)

T3 measurement was taken at the end of semester. Global Physical Activity Questionnaire (GPAQ; Armstrong and Bull, 2006).

for one term. Self-report measures, assessing perceived stress, mood/affect, QoL, and habitual physical activity behavior before, during and after the interventions (at the end of one semester), were administered. The interaction effect of *group* × *time* on self-reported perceived stress, mood/affect and QoL was not significant. Concerning physical activity, there was a significant interaction effect of *group* × *time* with a decrease in activity level for the cognitive intervention group, while the physical activity group had a stable unchanged activity level from the beginning to the end of one semester.

These findings point toward differential and specific effects of the interventions. Compared to the cognitive intervention, the physical activity intervention may have helped to better become aware of physical activity behavior and thus, to keep up one's physical activity level across the time course of the term. This is also supported by the fact that the cognitive intervention group started with a higher physical activity level than the physical activity group at T0 (baseline). Nevertheless, physical activity dropped from T0 to T3. Whether this is biased by a negative effect of the cognitive intervention on

physical activity of the students, cannot be confirmed in the present study, but should definitely be exploited in further studies. Likewise, whether the physical activity intervention served as a buffer for possible inactivity effects during the assessment period, should be investigated in future studies, as this would support the assumption that even a single bout (here session) of short-term exercises can temporarily change physical activity. Alternatively, a lower time of physical activity per day might be generally maintained, even without any intervention. This can only be explored by including a passive control group. Therefore, another study comparing physical activity and cognitive interventions with a passive control group should be conducted.

Positive effects of physical activity interventions on physical activity levels are mainly found in classroom-based studies with school children (e.g., Murtagh et al., 2013; Drummy et al., 2016). These findings cannot be generalized to university students, therefore, further studies, examining effects of physical activity breaks on physical activity levels in university and college students, are needed. The specific effects of work, travel or recreational activity in this study were not significant, while the overall physical activity interaction between *time* and *group* was. Still, the descriptive analysis pointed toward changes in traveling as well as vigorous-intensity recreational activity. Whether there is an association between these changes and the kind of intervention, needs to be examined further. It would be interesting to know, whether the activity break was also carried out during leisure time as well, or whether it could lead to the maintenance of carrying out one's own preferable type of exercise. In the current study, physical activity was measured subjectively via questionnaire. A good objective measure for future studies could be accelerometry or heart rate monitoring (Strath et al., 2013).

The results and intervention design of the present pilot study can be seen as a starting point for recommendations for the inclusion of physical and cognitive activity breaks in the learning context of university students during the current Covid-19 pandemic. As already mentioned, the exercises chosen are based on important exercise dimensions, fostering endurance and strength, relaxation and ballroom. All exercises are provided at an intensity, duration, frequency and expertise level that allows their engagement without much practice. Our interventions might even be extended to different settings outside the university context, e.g., office buildings or home office, or to different target groups, e.g., older people. Since many people suffer from a rather inactive lifestyle, even more so because of Covid-19, and stress also being on the rise (Techniker Krankenkasse, 2016), physical activity and stress regulatory programs are urgently needed, even for target groups, that do not suffer from any health burdens at the start of the Covid-19 pandemic. During times like these, where social distancing is so far one of the best ways to combat the Covid-19 pandemic, we are in need of suitable, short space- and time-efficient activity programs (e.g., Lippi et al., 2020; Woods et al., 2020), as provided in the present pilot study. Furthermore, positive expressive writing does not cause the unwanted side effects of traditional expressive writing about negative events, the latter leading to an increase in negative mood after the first sessions, before unfolding positive effects earliest after the fourth session (Pennebaker and Chung, 2007). Descriptive analysis of word use of the texts written by participants of the cognitive intervention group showed, that on average, use of positive words was higher than use of negative words. This suggests a positivity bias (e.g., Herbert et al., 2019). Theoretically, a positivity bias can act as buffer against negative mood and mental ill health, as suggested by broaden-and-build theory (Fredrickson, 1998). On top of that, positive expressive writing might be a suitable activity for people that are rather not interested in exercising.

Regarding the current Covid-19 pandemic, students can surely benefit from the physical, as well as the cognitive intervention, if both interventions will be provided as online interventions. With regard to physical activity levels, smartphone physical activity interventions showed to be promising in increasing activity during leisure time (Feter et al., 2019). Since the type of exercise as well as its intensity and pre-existing health burdens of the exerciser play a significant role with respect to which protective effects an exercise intervention can exert on mental health (Gronwald et al., 2018), the exercises included in the current intervention should be rated by experts for their effectivity beforehand (e.g., see recommendations by Herbert et al., 2020a).

Physical activity and exercise interventions can be regarded as promising with high effect sizes, concerning the decrease of depressive symptoms and anxiety disorders (Huang et al., 2018). We assessed mental health at T0, i.e. prior to the start of the intervention. Assessment included, amongst others, risk for depression and eating disorders at T0 (baseline before the start of the interventions). The rate of mental diseases like depression and anxiety in university and college students is high (Huang et al., 2018), specifically now during Covid-19 (Islam et al., 2020). Furthermore, risk of eating disorders and body dissatisfaction, an important predictor of eating disorders, seem to be prevalent and common in academic samples of adults (e.g., Eisenberg et al., 2011; Radwan et al., 2019). Interestingly, in the present small sample, depression scores and the risk for eating disorders were considered low, compared to standardized norms or cut-off scores. Nevertheless, depression and risk for eating disorders could have been higher during the term and at the end of term. In total, no significant interaction effects of *group* and *time* were found for university students' perceived stress, self-reported positive and negative state affect, the reported sedentary time, and psychological and physical dimensions of QoL from T0 (baseline before the intervention) to T3 (at the end of one term). This suggests, that both interventions had no differential effects on these variables. Interestingly, this was the case, although at T0, the two intervention groups differed in age and mean score of depressive symptoms, as assessed with the BDI-II (Beck et al., 1996; German version by Hautzinger et al., 2006). The mean scores of the student samples, participating in the two interventions, were comparable on all other dimensions at baseline (T0), including global physical activity behavior.

Although mental health did not increase due to the interventions in this study, other studies point toward positive effects of both kind of interventions on mood and perceived stress (e.g., Dolbier and Rush, 2012; Pennebaker, 2018; Kramer, 2020). With regard to perceived stress, it could be presumed, that an increase would have taken place from T0 to T3, because of T3 having been during examination period at the end of term. Since there was no significant effect of *time*, both interventions might have successfully buffered the negative effects of exams on university students' mental and physical health. Given that a group receiving no intervention was not included in the study, to allow every student interested in the study to benefit from an intervention, we cannot make any inferences about usual changes in mental health. Whether a passive control group without intervention showed an increase in perceived stress toward the end compared to both active interventions remains unknown. This should definitely be evaluated in future studies. Still, we refer to the literature and the teaching curricula, clearly documenting an increase of academic stressors within the time period of T3. Hence, the present results concerning perceived stress and also affect and QoL could have emerged because of a heightened stress level, lower positive and higher negative affect and lower QoL during examination period. Since there were no direct measurements taken right before and after each session, short lived immediate effects on students' mood and well-being were not captured. This would be an interesting research topic for future studies.

It should be noted that the exercises we offered can be characterized as being of low dose, i.e., possibly too low to elicit any physiological training effects across the six weeks of the interventions. Nevertheless, the exercises of our physical activity intervention could be expected to have good effects for previously sedentary students. Studies support the notion that even short breaks in sedentary behavior can have positive effects on the body (e.g., might help to control adiposity; Chastin et al., 2015) and on mental health (e.g., lower the odds of depression and anxiety symptoms; Hallgren et al., 2020). Therefore, our physical activity break might be appropriate to use as such a break regarding sedentary behavior. The exercises can be carried out without the use of much space or time and are therefore suitable for people with a high sedentary time such as university students (Castro et al., 2020). Overall sedentary time did not change in the current study, but interruptions in sedentary time were not assessed. This should be done in future studies.

A few limitations of the current study need to be addressed. Concerning the very small final sample size of our pilot study, *post-hoc* power analysis (Gpower, Faul et al., 2009) recommends a sample size of $N = 98$ in order to get a medium effect size with a Type I error probability of 0.05 and a power of 0.80 (as recommended by Cohen, 1988). Therefore, a higher sample size in order to increase power is needed. Of note, as mentioned under "Aim of this pilot study", the final sample was an all-female sample. For this reason, the interpretation of results, as well as the use of interventions, might be reliable for female university students. Future studies should include male students and students of different courses of study to increase generalizability. However, the exercises included in the physical activity break, as well as the cognitive intervention, are based on basic skills that might not vary dramatically across gender. In this study randomization was not carried out in order to prevent an unbalanced design due to different sizes of lectures. However, this limits internal validity. Therefore, future studies should use an experimental design with randomization of students.

All in all, the exercises included in the physical activity break as well as the cognitive intervention can easily be integrated into the university context, e.g., by offering them either during online lectures or on-site at university, which might also lower the feeling of loneliness and isolation, if carried out together. Alternatively, the interventions can be offered app- or web-based, to be carried out asynchronously at home by oneself. The approach of the present interventions, even their combination (physical activity and positive expressive writing), could produce good adherence, because of their multimodality and flexibility and the possibility to be included easily as breaks in between learning and working hours (Hammami et al., 2020). In summary, extending existing research to provide programs to fight sedentarism, physical inactivity and mental ill health during the current Covid-19 pandemic, the developed and explored activity breaks used in this pilot study might be seen as fruitful endeavors.

DATA AVAILABILITY STATEMENT

The data supporting the conclusions of this article will be made available by the corresponding author, without undue reservation, to any qualified researcher. Due to the informed consent form in which the possibility of raw data being published online was not explicitly stated, only group-level data, as it is provided in this article, can be made accessible upon request.

ETHICS STATEMENT

Participants had to give written informed consent to confirm the exclusion criteria and were debriefed about the purpose of the study, following ethical guidelines and study protocol standards, used in the department's previous physical activity and cognitive intervention studies, which had been approved by the local ethics committee of Ulm University (https://www.uni-ulm.de/einrichtungen/ethikkommission-der-universitaet-ulm/). Therefore, for this study, no ethics approval was submitted before the start of the study.

AUTHOR CONTRIBUTIONS

VM and CH (contributed equally): conceptualization, writing—original draft, and review and editing. VM and CH: data curation, methodology, validation, and investigation. VM: formal analysis and visualization. CH: resources, supervision, project administration, and funding. All authors have approved the final version of the manuscript. Both authors contributed equally to the parts with equal contribution.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.645492/full#supplementary-material

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A Path Analysis Model of Protection and Risk Factors for University Academic Stress: Analysis and Psychoeducational Implications for the COVID-19 Emergency

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The aim of this research was to empirically validate hypothesized predictive relationships of protection and risk factors for experiencing academic stress. A synthesis of models—the presage–process–product model; the studying, learning and performing under stress competency model; and self- vs. external-regulatory theory—underlies the investigation and is important for assessment and guidance in stress situations within the university context. Over the course of an academic year, a sample of 564 Spanish university students voluntarily completed validated questionnaires, in an online format, on several psychological variables connected to academic stress. Correlational analysis and the path analysis model, within an *ex post facto* design, were used to build empirical models of the presage–process–product factors that constitute protection or risk factors in academic stress. Two statistically acceptable models appeared: one with protection factors and another with risk factors in predicting and preventing academic stress at a university. These results support the need for psychology units at university that have a preventive, health and education focus, going beyond the merely clinical. Focus on an individual is insufficient, given that there are also contextual factors that predispose academic stress. Discussion, conclusions, and implications for assessment and intervention in academic stress in university students and teachers, within the present COVID-19 crisis, are offered.

Keywords: academic stress, protection and risk factors, 3P model, SLPS competency model, SRL vs. ERL theory, university students, COVID-19

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INTRODUCTION

Human beings require learning experiences in order to restructure their knowledge and their ways of interacting with reality; today, COVID-19 has become such an experience—unusual, unexpected, but common among us all. In the field of healthcare, it is an object of analysis and learning. It is obvious that COVID-19 has all the components of a health and medical-biological emergency, just as what was declared by the WHO. The configuration, functionality, and structure of this fast-spreading biological entity are not yet clearly understood. Knowledge has been lacking about its primary care, through conventional pharmacological prevention (vaccines),

and its secondary or tertiary care (pharmacological treatment, ventilators, etc.). As a consequence, the disease is now pandemic and growing by geometric progression.

To evaluate and intervene in behavioral variables (psychoeducational and psychosocial) is the business of psychology as a behavioral science. It is time to recognize that many health-related issues have both a medical-biological component and a psychosocial component (behavioral, personal, and contextual). We must learn that medicine, biology, and psychology should work together on epidemiological and health-related issues from an integrated, biopsychosocial model (de la Fuente, 2020a; Frazier, 2020).

In the context of today, educational psychology—as a specialized branch of scientific knowledge in psychology—can contribute its own elements and models in the realm of academic stress. This article thus has a 3-fold aim: (1) present a conceptual–synthesis model or heuristic based on previous conceptual models that have provided evidence (Slavin, 2019); (2) empirically demonstrate the hypothesized relationships in university students; (3) present implications and proposals for intervention to help educational psychologists evaluate and advise students, teachers, and university institutions during the COVID-19 health crisis. An example of this purpose is the *Research Topic* in which the present research report is included (de la Fuente et al., 2021a).

In a complementary fashion, this exploratory study seeks to offer an empirical and conceptual synthesis of different theoretical models in the line of research that analyzes variables connected with stress behavior in the university context. A few partial contributions have been put forward to date, which we seek to integrate into this final model or heuristic.

The 3P Model for Analysis Within the COVID-19 Health Emergency

The 3P (presage–process–product) model, or theory of Biggs of student approaches to learning (SAL) (Biggs, 1970a, 1985, 1993, 1999), is an essential conceptual heuristic for addressing the prevention of academic stress, particularly in the context of the COVID-19 health crisis. It presents a systemic view of university teaching and learning processes and has become one of the seminal models that are most prevalent in the literature (Barattucci et al., 2017; Ginns et al., 2018; Kember et al., 2020):

1) *Presage variables*. Evidence has demonstrated the existence of different *presage* variables of university learning and academic achievement. Biggs himself proposed influence coming from personality factors (Biggs, 1970a) and factors of the faculty context (Biggs, 1970b) as precursors to the learning approach of the students at a university (Chamorro-Premuzic et al., 2007; Ginns et al., 2018). Positive psychology has recently contributed new elements for consideration, such as positivity as dispositional optimism (Caprara and Steca, 2005; Caprara et al., 2006, 2009, 2010, 2011; Alessandri et al., 2012). Relationships have also appeared between personality and academic confidence (Sander and de la Fuente, 2020).
2) *Process variables*. The core research, using this model, has historically focused on learning approaches as an essential process variable (Biggs, 1972, 1973, 1976, 1978, 1985, 1987). Classical cognitive research established associations and predictive relationships with cognitive variables like learning strategies, metacognitive processes, and self-regulated learning (Heikkilä and Lonka, 2006; de la Fuente et al., 2008). This paradigm has evolved toward the study of emotional and affective factors in our day, establishing relationships between learning approaches and several variables of this type (Trigwell and Ashwin, 2003; Trigwell, 2006, 2012; Trigwell et al., 2012, 2013).
3) *Product variables*. Finally, the *product* variable is understood to be achievement or satisfaction, and previous research showed a predictive relationship between learning approaches and achievement (Karagiannopoulou et al., 2018).

The 3P model can serve as a general heuristic for evaluating complex realities, such as that of COVID-19 in the university context. However, despite the wide range of evidence and research on this topic, an essential aspect of reality has not been thoroughly analyzed, namely, the high level of environmental and personal stress that exists in this context. This limitation has given rise to other complementary heuristics that address elements of the model that can be improved. Such is the case of the *SLPS Competency Model* (de la Fuente, 2015a).

Competence in Studying, Learning, and Performing Under Stress as a Model for Analysis Within the COVID-19 Health Emergency

The (Original) SLPS Competency Model (V.1)

The educational psychology model of competence in *studying, learning, and performing under stress* (SLPS) (de la Fuente, 2015a) is based conceptually on the Gagné instructional model (Gagné, 1985), taking into account three levels of learning that are required to be competent. It focuses on the process variables of the 3P model (Biggs, 1993), since it establishes behaviors that make up appropriate repertories for dealing with academic stress situations. Given the current COVID-19 crisis, it seems reasonable that this model can be useful to evaluate and intervene with university students who so require. See **Table 1**.

The *learning approaches* variable was considered a meta-learning variable by Biggs himself (1985). Both the theory of learning approaches (Biggs, 1993; Asikainen and Gijbels, 2017) and its assessment instrument (Biggs et al., 2001) have become established internationally. Recent research has consistently shown that *deep approach* is associated with better learning and achievement at a university, while *surface approach* is associated with poorer university learning and achievement (Cetin, 2015; Asikainen and Gijbels, 2017). Learning approach has recently been related to coping strategies and resilience, with deep approach related to problem-focused strategies and high resilience, and surface approach to emotion-focused strategies and low resilience (de la Fuente et al., 2017a; Banerjee et al., 2019). Relationships have recently been established between *learning*

TABLE 1 | The competency model of studying, learning, and performing under stress, SLPS original (de la Fuente, 2015a).

Knowing (knowledge):
- Facts
- Concepts
- Principles

Knowing how (skills):
- Instrumental skills: written and oral skills
- Learning and study skills: study skills and techniques
- Meta-cognitive skills for study: **learning approaches**
- Meta-emotional skills for managing stress: **coping strategies**
- Meta-behavioral skills for managing stress: **self-regulation vs. procrastination strategies**
- Meta-motivational skills for managing stress: **resilience**

Knowing how to be (attitudes):
- Achievement emotions: **positives vs. negatives**
- Attitudes and values: **academic behavioral confidence**
- Emotional motivation: **engagement- burnout**

The variables on which this research has focused are highlighted in bold.

approach (deep vs. surface) and *achievement emotions* (positive vs. negative), respectively (de la Fuente et al., 2020e).

Self-regulation, as a meta-behavioral variable, has also been related to a number of variables: in positive association with type of coping strategies used (de la Fuente, 2020a,b), positive achievement emotions (de la Fuente et al., 2020c), academic behavioral confidence (de la Fuente et al., 2020f), and deep learning approach (de la Fuente et al., 2021c), and in negative association with procrastination (Garzón-Umerenkova et al., 2018).

Coping strategies, as a meta-affective variable, have also shown a relation to the states of engagement burnout (de la Fuente et al., 2015a). Moreover, a recently proposed relationship model, including achievement emotions, emotion- vs. problem-focused coping strategies, and ultimate state of engagement burnout, has also acted as a potential 2-fold mechanism in positive vs. negative perfectionism (de la Fuente et al., 2020b). Coping strategies have also been related to the self-regulation characteristics of students (Amate-Romera and de la Fuente, 2021).

Resilience also has been studied as a meta-motivational variable, mediating between personality characteristics and perceived stress (de la Fuente et al., 2021f). Other studies examine its predictive value for coping strategies and the motivational states of engagement burnout (de la Fuente et al., 2021d).

Achievement emotions likewise have been studied widely in recent research, with much important evidence. Positive and negative relationships have been verified in different stress situations according to the source of the stress triggers (related to class, study time, or testing) (de la Fuente et al., 2020c).

Regarding *academic behavioral confidence* (Sander and Sanders, 2006, 2009; Sander, 2009; Sander et al., 2011), prior research showed its positive relationship to deep learning approach and to academic achievement (de la Fuente et al., 2013). More recently, a relationship to positive achievement emotions has also been found (Sander and de la Fuente, 2020).

The (Adapted and Integrated) SLPS Competency Model as a Buffering Variable When Facing Academic Stress (V.2)

The *competency model for studying, learning, and performing under stress*, SLPS (the adapted and integrated model; de la Fuente, 2021) assumes that, if a university student has an adequate level of the learning behaviors that make up this competency, these behaviors will act as *protective factors* or *buffers* against stress. The student will be able to adequately cope with academic stress situations and ultimately have fewer learning problems and stress symptoms (de la Fuente, 2015b,c). However, there are also risk factors that can predispose a greater experience of academic stress.

Despite the goodness of this model, it still underplays *contextual factors* (the design and development of teaching) that can also carry weight as protection or risk factors in experiencing stress. For this reason, contributions from SRL vs. ERL theory have also been taken into account (de la Fuente, 2017). **Figure 1** shows a graphic representation of this adapted model in the context of the former models.

SRL vs. ERL Theory in the COVID-19 Health Emergency

The SRL vs. ERL Model as a Heuristic for Analyzing Stress Factors in the University Teaching and Learning Process

The *theoretical model* entitled *SRL vs. ERL theory* (de la Fuente, 2017; de la Fuente et al., 2019a) seeks to straightforwardly identify the possible combinations of internal and external regulations that can occur in any university teaching–learning process. Basically, *students* are assumed to have different levels of behavioral self-regulation (high, medium, and low); they take on a given learning process from different starting points (with regulating, non-regulating, or dysregulating behaviors). In the same degree, teachers can show diverse teaching behavior in regard to external regulation (high, medium, and low); their teaching behaviors affect learning in ways that can be regulatory, non-regulatory, or dysregulatory (Pachón-Basallo et al., 2021). These two typologies in students and teachers are then combined in the teaching-learning process, giving rise to multiple interactions. Recent research has presented a heuristic that organizes the different possible interactions and has also tested their effects, with consistent evidence in relation to learning approaches and academic achievement (de la Fuente et al., 2020d), and to the factors and symptoms of stress (de la Fuente et al., 2020f).

Prior evidence reported on (1) the effect of the levels of self-regulation of students (high, medium, and low) on their learning behaviors and on emotional resources that they engage in during university learning; (2) the effect of the level of regulatory teaching (high, medium, and low) on learning behaviors and on the emotional resources that students engage in during university learning; (3) the combined effect of the different possible interactions between student and teacher regulatory levels, representing these as a consistent, increasing or decreasing linear function, according to the variable analyzed.

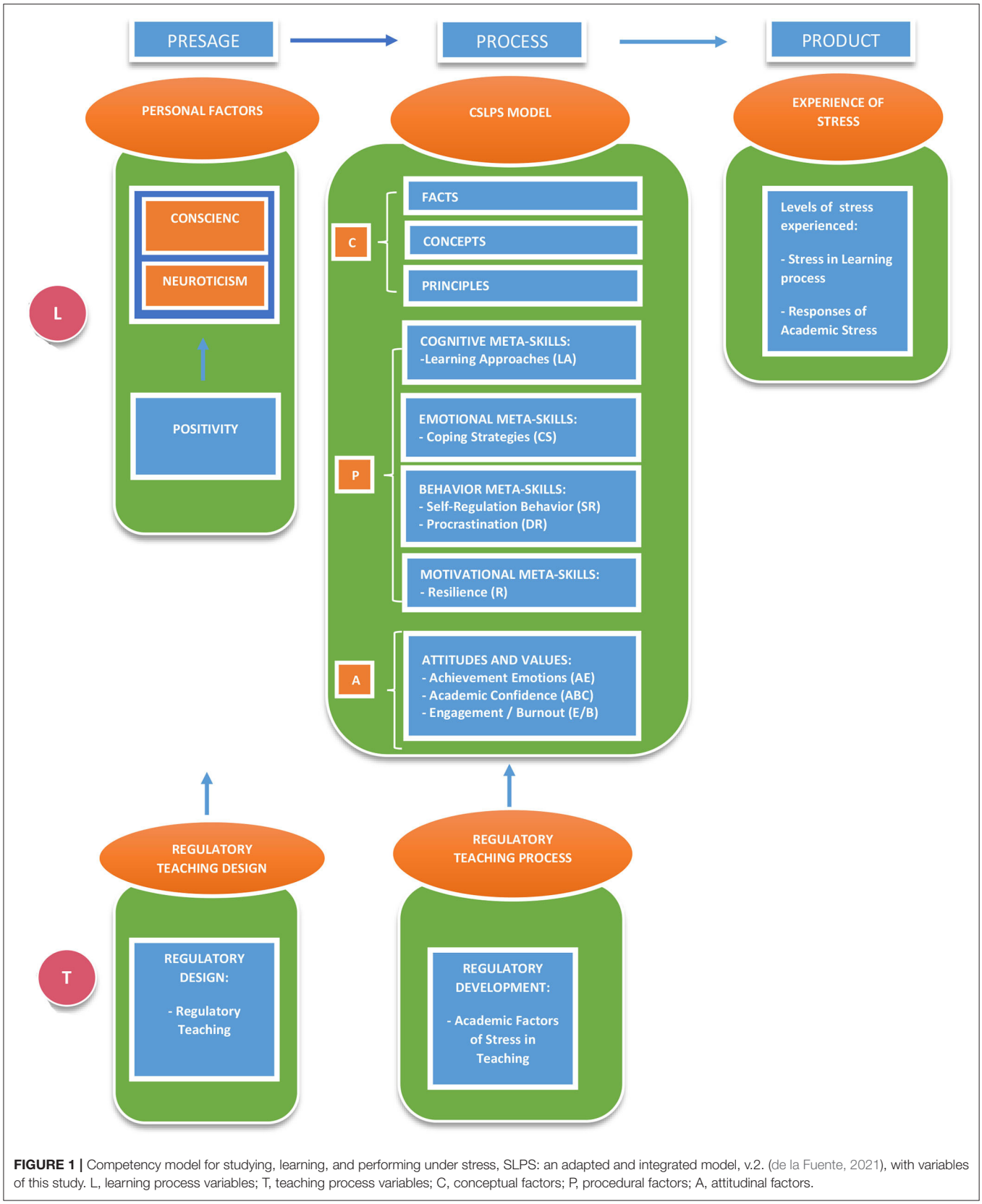

FIGURE 1 | Competency model for studying, learning, and performing under stress, SLPS: an adapted and integrated model, v.2. (de la Fuente, 2021), with variables of this study. L, learning process variables; T, teaching process variables; C, conceptual factors; P, procedural factors; A, attitudinal factors.

Thus, the combination of different levels of regulation—from the lowest and most dysregulatory to the highest and most regulatory—has been found to determine the positive and negative achievement emotions of university students, as well as emotion- or problem-focused coping strategies (de la Fuente et al., 2019b, 2020a,b). This combination, moreover, has been found to determine learning approaches, perceived satisfaction, and personal achievement, as well as academic behavioral confidence and procrastination (de la Fuente et al., 2020b,c). In turn, characteristics of the teaching process determine the factors and symptoms of the stress of the students when learning (de la Fuente et al., 2021a,c,e,f). In summary, the stress reactions of university students depend on *personal* factors and also on *contextual* factors or the type of teaching process deployed.

This theoretical model proposes *effective* or *regulatory teaching* as a *buffering* factor against academic stress. Insofar as the teaching process is regulatory or effective, it will minimize the effect of stress during the learning process, particularly in this exceptional context of COVID-19. The teaching process during this period should be regular, clear, and predictable. Any radical, disorienting changes or adjustments during this period will not contribute to a buffering effect against stress but will become stress triggers (Barattucci, 2017; de la Fuente et al., 2017b). This schema has also been applied to psychoeducational behavior analysis in the COVID-19 health emergency (de la Fuente et al., 2021b).

The three preceding models have been conceptually merged in an updated, integrated version (de la Fuente, 2021; V.2), taking into account variables from the teaching process, which were not present in the original model (de la Fuente, 2015a). See **Figure 2**.

Aims and Hypotheses

Based on the conceptual synthesis presented, the *aim* of this research was to empirically analyze the hypothesized relationship between personal characteristics of students (*presage* variables); their *competency for learning under stress,* as a protective or buffering variable against stress (a *process* variable); and their learning difficulties and final stress levels (a *product* variable) in order to establish implications for evaluation and intervention in a situation with high academic stress, such as the COVID-19 health emergency. Based on previous research and the existing evidence, the following relationships were hypothesized in situations of academic stress:

Hypothesis 1. There will be a *structural predictive relationship*, *protecting* against academic stress, that comprises the following: (1) *presage factors*, including the personality component of *conscientiousness* and its associated positivity; (2) *process factors* with a buffering effect, that are part of the competence for coping with stress (meta-cognitive, meta-emotional, meta-motivational and meta-behavioral, and attitudinal variables); (3) *product factors*: a low level of learning-related or academic stress as final dependent variables of the prediction.

Hypothesis 2. The relationship established in hypothesis 1 will be modulated positively by factors of the teaching context: (1) *Presage factors*: high regulatory teaching; (2) *process factors:* low stress factors from difficulties in the teaching process: (3) *product factors*: a low level of learning-related or academic stress as final dependent variables of the prediction.

Hypothesis 3. There will be a *structural predictive relationship* of *vulnerability* to academic stress that comprises: (1) *presage factors*, including the personality component of *neuroticism* and its associated lack of positivity; (2) *process factors* that pertain to a lack of competence for coping with academic stress (lack of meta-cognitive, meta-emotional, meta-motivational and meta-behavioral, and attitudinal variables); (3) *product factors*: a high level of learning-related or academic stress as final dependent variables of the prediction.

Hypothesis 4. The relationship established in Hypotheses 3 will be modulated negatively by factors of the teaching context: (1) *Presage factors*: low regulatory teaching; (2) *process factors:* high stress factors from difficulties in the teaching process: (3) *product factors*: a high level of learning-related or academic stress as final dependent variables of the prediction.

METHOD

Participants

The participants were 564 students enrolled in Psychology and Primary Education degrees at two Spanish universities. Their ages ranged from 19 to 25, with a mean age of 22.35 ($^{\sigma}X = 7.1$) years. Students age 26 and older were excluded. About 80.3% were women and 19.7% were men. Sampling was incidental and not probabilistic. The students from 20 different academic subjects completed the inventories. An incidental, non-randomized study design was used. Each Guidance Department of the universities invited participation from teachers, and the teachers invited their students to participate on an anonymous, voluntary basis. Each course (subject) was considered one specific teaching–learning process. The students completed the questionnaires online for one subject over one academic year. Only the students who voluntarily wished to participate did so.

Instruments

Presage Factors

Conscientiousness and neuroticism (*personal factors*) were assessed, using the *big five questionnaire* BFQ-N (del Barrio et al., 2006) based on Barbaranelli et al. (2003), and adapted for young university students (de la Fuente, 2014a). Confirmatory factor analysis (CFA) reproduced a five-factor structure corresponding to the big five model. The results showed adequate psychometric properties and acceptable fit indices. The second-order confirmatory model showed a good fit [chi-square = 38.273; degrees of freedom (20–15) = 5; $p < 0.001$; NFI = 0.939; RFI = 0.917; IFI = 0.947; TLI = 0.937, CFI = 0.946; RMSEA = 065; HOELTER = 2,453 ($p < 0.05$) and 617 ($p < 0.01$)]. The total scale also showed good internal consistency [alpha = 0.956; Part 1 = 0.932, Part 2 = 0.832; Spearman–Brown = 0.962; Guttman = 0.932].

Positivity (*personal factor*). Measured by the *Escala de Positividad* (positivity scale) (Caprara et al., 2012). This scale contains 10 items on a five-point Likert response scale. The Spanish validation data for our sample produced acceptable

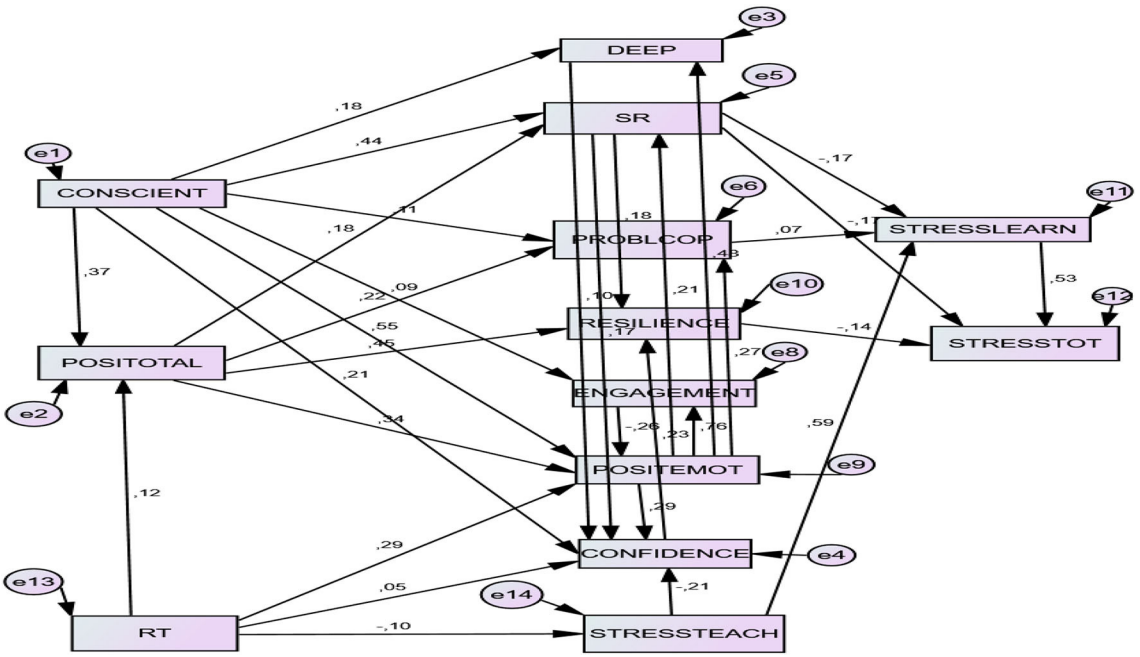

FIGURE 2 | A structural predictive model of protective factors against academic stress (Model 2). CONSCIENT, conscientiousness; POSITOTAL, Positivity; DEEP, deep approach; CONFIDENCE, academic behavioral confidence; SR, self-regulation; PROBLCOP, problem-focused coping; POSITEMOT, positive achievement emotions; RT, regulatory teaching; STRESSTEACH, stress factors of teaching process; STRESSLEARN, stress factors of learning process; STRESSTOT, symptoms of stress.

values [chi-square = 308.992; degrees of freedom (44–20) = 20; $p < 0.001$; NFI = 0.901; RFI = 0.894; IFI = 0.912 TLI = 0.923, CFI = 0.916; RMSEA = 0.085; HOELTER = 260 ($p < 0.05$) and 291 ($p < 0.01$)]. The total scale also showed good internal consistency (alpha = 0.893; Part 1 = 0.832, Part 2 = 0.813; Spearman–Brown = 0.862; Guttman = 0.832).

Process Factors

Learning Variables

Learning approaches (a meta-cognitive factor) were measured by the revised two-factor *study process questionnaire*, *R-SPQ-2F* (Biggs et al., 2001). Twenty items measure two dimensions: deep learning approach (e.g., "I find that, at times, studying gives me a feeling of deep personal satisfaction") and surface learning approach (e.g., "My aim is to pass the course while doing as little work as possible"). Students answer the items on a five-point Likert scale from 1 ("rarely true of me") to 5 ("always true of me"). The R-SPQ-2F was translated into Spanish, adapted for cultural differences, independently back-translated, and further modified where needed. Using a Spanish sample, Justicia et al. (2008) showed a confirmatory factor structure similar to that of Biggs et al. (2001)—a first-order structure of two factors. These authors also reported acceptable reliability coefficients. In this study, confirmatory factor analysis produced a second factor structure with two factors (chi-square = 2,645.77; df = 169, CFI = 0.95, GFI = 0.91, AGFI = 0.92, RMSEA = 0.07). In the present study, Cronbach alpha reliability coefficients were acceptable (Deep $\alpha = 0.81$; Surface $\alpha = 0.77$) and similar to what the original authors found (omega index = 0.85).

Self-regulation behavior (a meta-behavior factor). This variable was measured, using the *short self-regulation questionnaire* (SSRQ) (Miller and Brown, 1991). The Spanish adaptation was previously validated in Spanish samples (Pichardo et al., 2014, 2018), showing acceptable validity and reliability, with values similar to the English version. Four factors (goal setting-planning, perseverance, decision-making, and learning from mistakes) were measured by a total of 17 items (all with saturations >0.40). The confirmatory factor structure is consistent (chi-square = 250.83, df = 112, CFI = 0.90, GFI = 0.92, AGFI = 0.90, RMSEA =0.05). Internal consistency was acceptable for the questionnaire total ($\alpha = 0.86$) and for three factors: goal setting-planning ($\alpha = 0.79$), decision-making ($\alpha = 0.72$), and learning from mistakes ($\alpha = 0.72$). The perseverance factor showed low internal consistency ($\alpha = 0.63$); omega index = 0.75.

Procrastination (a negative meta-behavior variable). For this variable, we used a validated Spanish version of the *procrastination assessment scale-students* (PASS) (Garzón-Umerenkova and Gil-Flores, 2017). The original scale by Solomon and Rothblum (1984) consists of 44 items under two sections. The first section uses 18 items to assess procrastination frequency. Our study made use only of the second section, items 19 to 44, which investigates the cognitive-behavioral reasons for procrastination. On the five-point answer scale, 1 means "It does not reflect my motives whatsoever," 3 means "It reflects my motives to an extent," and 5 means "It reflects my motives completely." In its validation for Spain, a language adjustment was made, and adequate reliability values

were obtained (Cronbach's alpha from 0.71 to 0.82; omega index = 0.76). The confirmatory model showed a good fit [chi-square = 944,633; degrees of freedom (350–85) = 265; $p < 0.001$; NFI = 0.921; RFI = 0.915; IFI = 0.936; TLI = 0.926, CFI = 0.932; RMSEA = 0.032; HOELTER = 533 ($p < 0.05$) and 565 ($p < 0.01$)].

Coping strategies (meta-emotional factor). The *coping strategies scale* (*EEC*) was used in its original version (Sandín and Chorot, 2003), as validated for university students (de la Fuente, 2014b). The Lazarus and Folkman questionnaire (1984) and coping assessment studies by Moos and Billings (1982) were foundational to this scale, constructed according to theoretical-rational criteria. The original instrument contained 90 items. The validation produced a first-order structure with 64 items and a second-order structure with 10 factors and two dimensions, both of them were significant. The dimensions showed adequate fit values [Chi-square = 878.750; degrees of freedom (77–34) = 43, $p < 0.001$; NFI = 0.901; RFI = 0.945; IFI = 0.903, TLI = 0.951, CFI = 0.903]. The measures confirming reliability were Cronbach alpha values of 0.93 (complete scale), 0.93 (first half) and 0.90 (second half), Spearman-Brown of 0.84 and Guttman 0.80, Omega index = 0.86. Eleven factors and two dimensions make up the questionnaire: (1) *Dimension: emotion-focused coping*: F1. Fantasy distraction; F6. Help for action; F8. Preparing for the worst; F9. Venting and emotional isolation; F11. Resigned acceptance; and (2) *Dimension: problem-focused coping*: F2. Help seeking and family counsel; F5. Self-instructions; F10. Positive reappraisal and firmness; F12. Communication of feelings and social support; F13. Seeking alternative reinforcement.

Resilience (a meta-motivational factor) was measured, using the CD-RISC scale (Connor and Davidson, 2003) in its validated Spanish version (Manzano-García and Ayala-Calvo, 2013). Adequate reliability and validity values were obtained in Spanish samples, and a five-factor structure: F1: Persistence/tenacity and a strong sense of self-efficacy (tenacity); F2: Emotional and cognitive control under pressure (stress); F3: Adaptability/ability to bounce back (change); F4: Perception of control (control), and F5: Spirituality. The confirmatory model showed a good fit [chi-square = 1,619,170; degrees of freedom (350–85) = 265; $p < 0.001$; NFI = 0.929; RFI = 0.948; IFI = 0.922; TLI = 0.908, CFI = 0.920; RMSEA = 0.063; HOELTER = 240 ($p < 0.05$) and 254 ($p < 0.01$); Cronbach alpha = 0.88; omega index = 0.85)].

Learning related emotions (an attitudinal factor) were measured by the achievement emotions questionnaire (AEQ) (Pekrun et al., 2002; Perry et al., 2005), with scales for nine different emotions (enjoyment, hope, pride, relief, anger, anxiety, hopelessness, shame, and boredom), measured along two axes. The nine different emotions include emotions occurring during activity (enjoyment, boredom, and anger), prospective outcome emotions (hope, anxiety, and hopelessness), and *retrospective* outcome emotions (pride, relief, and shame). The two axes address *valence*, whether positive or negative emotions, and *activation*, where emotions can be either activating or deactivating. The four resulting quadrants are able to classify the emotions as either: (1) *positive activating*: enjoyment, hope, and pride; (2) *positive deactivating*: relief; (3) *negative activating*: anger, anxiety, and shame; or (4) *negative deactivating*: hopelessness and boredom. In this sample, confirmatory factor analysis (CFA) reproduced a structure that corresponds to the AEQ model:

1) *Achievement emotions pertaining to class* (Paoloni, 2015). The results showed adequate psychometric properties and acceptable fit indices. The confirmatory model showed a good fit [chi-square = 843.028; degrees of freedom (44–25) = 19; $p < 0.001$; NFI = 0.954; RFI = 0.967; IFI = 0.953; TLI = 0.958, CFI = 0.971; RMSEA = 0.081; HOELTER = 156 ($p < 0.05$) and 158 ($p < 0.01$). Internal consistency for the total scale was good (Alpha = 0.904; Part 1 = 0.803, Part 2 = 0.853; Spearman–Brown = 0.903 and 853; Guttman = 0.862; omega index = 0.84). Sample items include item 1 (I get excited about going to class =; item 36 (I get bored); item 75 (I feel so hopeless—all my energy is depleted).
2) *Achievement emotions pertaining to study* (de la Fuente, 2015b). The results showed adequate psychometric properties and acceptable fit indices. The confirmatory model showed a good fit [chi-square = 729,890; degrees of freedom (44–25) = 19; $p < 0.001$; NFI = 0.964; RFI = 0.957; IFI = 0.973; TLI = 0.978, CFI = 0.971; RMSEA = 0.080; HOELTER = 165 ($p < 0.05$) and 178 ($p < 0.01$)]. The total scale also showed good internal consistency (alpha = 0.939; Part 1 = 0.880, Part 2 = 0.864; Spearman–Brown = 0.913 and 884; Guttman = 0.903; omega index = 0.87). Sample items include item 90 (I get angry when I have to study); item 113 (My sense of confidence motivates me); item 144 (I'm proud of myself).
3) *Achievement emotions pertaining to testing* (de la Fuente, 2015c). The results showed adequate psychometric properties and acceptable fit indices. The confirmatory model showed a good fit [chi-square = 376,658; degrees of freedom (44–25) = 19; $p < 0.001$; NFI = 0.978; RFI = 0.969; IFI = 0.983; TLI = 0.978, CFI = 0.963; RMSEA = 0.080; HOELTER = 169 ($p < 0.05$) and 188 ($p < 0.01$). Internal consistency for the total scale was good [alpha = 0.913; Part 1 = 0.870, Part 2 = 0.864; Spearman–Brown = 0.824 and 0.869; Guttman = 0.868; omega index = 0.88]. Sample items include item 170 (Before the exam, I feel nervous and uneasy); item 181 (I enjoy taking the exam); item 224 (I am very satisfied with myself).

Academic behavioral confidence (an attitudinal factor) was measured by the *academic behavioral confidence scale* (Sander and Sanders, 2006, 2009) in its validated Spanish version (Sander et al., 2011). The ABC scale was developed from and tentatively positioned against the established constructs of self-concept and self-efficacy. This psychometric scale is a self-report for undergraduate students from Spain and the UK, assessing their anticipated study-related behaviors (in a program assumed to consist largely of lecture-based courses). Four subscales comprise the total ABC scale and draw out crucially distinct aspects of the academic behavior of students: grades, studying, verbalizing, and attendance (Sander, 2009). Students respond to a question stem ("How confident are you that you will be able to...") for items, such as "...manage your workload to meet coursework deadlines" and "...write in an appropriate academic style." Answers are given on a five-point scale (1 = "not at all confident," 5 = "very

confident"). The higher the score, the greater the confidence of the students in using effective study skills or behaviors. Prior studies yielded a four-factor model (confidence in grade achievement, studying, attending class, and discussing course material) with adequate reliability and validity (Sander and Sanders, 2009). The confirmatory model showed a good fit [chi-square = 767,516; degrees of freedom (152–54) = 98; a probability level = 0.000; NFI = 0.969; RFI = 0.962; IFI = 0.973; TLI = 0.967, CFI = 0.973; RMSEA = 0.073; HOELTER = 203 ($p < 0.05$) and 222 ($p < 0.01$)]. Internal consistency for the total scale was good [alpha = 0.952; Part 1 = 0.932, Part 2 = 0.872; Spearman–Brown = 0.961; Guttman = 0.935; omega index = 0.87].

Engagement (a motivational factor). For this variable, we used a validated Spanish version of the *Utrecht Work Engagement-Burnout Scale* (Schaufeli et al., 2002; Schaufeli and Bakker, 2003). The psychometric properties were satisfactory with a sample of students from Spain. The model obtained good fit indices, showing a second-order structure of three factors: vigor, dedication, and absorption. Also verified were scale unidimensionality and metric invariance in the samples assessed (chi square = 792,526, df = 74, $p < 0.001$; CFI = 0.954, TLI = 0.976, IFI = 0.954, TLI = 0.979, and CFI = 0.923; RMSEA = 0.083; HOELTER = 153, $p < 0.05$; 170 $p < 0.01$). The Cronbach alpha for this sample was 0.900 (14 items); 0.856 (7 items) and 0.786 (7 items) for the two parts, respectively; omega index = 0.85.

Burnout (a motivational factor). The validated Spanish version of the *engagement-burnout scale* (Schaufeli et al., 2002) was used. The psychometric properties with a sample of students from Spain were satisfactory. Good fit indices were obtained, showing a second-order structure of three factors: exhaustion or depletion, cynicism, and lack of effectiveness. Also verified were scale unidimensionality and metric invariance in the samples assessed [chi square = 767.885, $df = 87$, $p < 0.001$; CFI = 0.956, TLI = 0.964, IFI = 0.951, TLI = 0.951, and CFI = 0.953; RMSEA = 0.071; HOELTER = 224, $p < 0.05$; 246 $p < 0.01$]. The Cronbach alpha for this sample was 0.874 (15 items); 0.853 (8 items) and 0.793 (7 items) for the two parts, respectively; omega index = 0.88.

Teaching Variables

Regulatory teaching (a meta-instructional variable). The student version of the assessment of the teaching-learning process (ATLP) (de la Fuente et al., 2012) was used to evaluate how students perceive the teaching process. The scale that addresses regulatory teaching constitutes Dimension 1 of the confirmatory model. The ATLP-D1 contains 29 items with a five-factor structure: specific regulatory teaching, regulatory assessment, preparation for learning, satisfaction with the teaching, and general regulatory teaching. Having been previously validated in university students (de la Fuente et al., 2012), the scale shows a factor structure with adequate fit indices (chi-square = 590.626; df = 48, $p < 0.001$, CF1 = 0.838, TLI = 0.839, NFI = 0.850, NNFI = 0.867; RMSEA = 0.068). Internal consistency is also adequate (ATLP D1: a = 0.83; specific regulatory teaching, a = 0.897; regulatory assessment, a = 0.883; preparation for learning, a = 0.849; satisfaction with the teaching, a = 0.883, and general regulatory teaching, a = 0.883); omega index = 0.80.

Factors of stress. Cuestionario de Estrés Académico (*CEA*) [Academic factors of a stress questionnaire] (Cabanach et al., 2008, 2016). In order to analyze the internal structure of the scale, we conducted a confirmatory factor analysis (CFA) of the whole set of data from our sample and thus verified the second-level structure. The default model has a good fit [chi-square = 66,457, df = 13, $p < 0.001$; CFI = 0.935, TLI = 0.961, IFI = 0.947, RFI = 0.965, and NFI = 0.947; RMSEA = 0.057; HOELTER = 0.430 ($p < 0.05$) and 0.532 ($p < 0.01$)]. The proposed model contains 53 items with a seven-factor structure and two dimensions, where one factor differs from the original version. The resulting factors were (1) *stress in learning dimension*: task overload (Factor 2), difficulty performance control (F3), social climate (Factor 5), and test anxiety (Factor 7); (2) *Stress in teaching dimension*: methodology difficulties (Factor 1), public interventions (Factor 4); content lacks value (Factor 6). Overall reliability = 0.961; part 1 = 0.932, part 2 = 0.946; omega index = 0.88.

Product Factors

Effects of Stress. Stress response questionnaire (*CRE*) (Cabanach et al., 2007). We found adequate psychometric properties for this scale in this sample of Spanish students. The confirmatory structural model of the CRE has the following dimensions [Chi-square = 846.503; Degrees of freedom (275–76) = 199, $p < 0.001$; NFI = 0.952; RFI = 0.965; IFI = 0.953): F1. Burnout; F2. Sleep difficulties; F3. Irritability; F4. Negative thoughts; F5. Agitation. Scale unidimensionality and metric invariance in the samples were confirmed [RMSEA = 0.046; CFI.922 and TLI 0.901; HOELTER = 431 ($p < 0.05$) and 459 ($p < 0.01$)]. Cronbach's alpha was 0.920, part 1 = 0.874 and part 2 = 0.863; omega index = 0.90.

Procedure

The students were informed about the research, and the volunteers completed the online self-informed consent on the *e-Coping with Stress Platform* (de la Fuente, 2015b) [http://www.inetas.net]. The questionnaires were then completed outside of normal class hours. They were asked to complete the questionnaires over one semester, during the period of September 2019 to February 2020. They completed one of the questionnaires each weekend in the order in which they were presented in the description; each questionnaire was completed one time during a 13-week period. A *Certificate of Participation in R & D Project* (10 h) was awarded, acknowledging the number of participation hours.

The platform organized the data anonymously, assigning a number to each user, whereby the different completed inventories were associated accordingly. The R and D Project was approved by the ethics committee of the University of Navarra (Ref. 2018.170).

Data Analysis

An *ex post facto*, transversal design of linear analysis was used to test the hypotheses.

Preliminary Analyses: Normality Assumptions

First, we explored the quality of the data by testing for outliers and missing cases. We tested for *univariate* outliers by calculating the typical scores for each variable, considering cases with Z scores outside the +/−3 range to be potentially atypical cases (Tabachnick and Fidell, 2001a,b). In addition, the Mahalanobis distance (D2) was used to detect atypical *combinations* of variables (atypical multivariate cases), a statistical measure of multidimensional distance of an individual from the centroid or mean of the given observations (Lohr, 1999). This procedure detects significant distances from the typical combinations or centroids of a set of variables. The literature suggests removing univariate and multivariate outliers, or reassigning them the nearest extreme score (Weston and Gore, 2006). The procedure was carried out, using SPSS (v.26, IBM, Armonk, NY, USA), which includes a specific routine for missing values analysis that determines the magnitude of missing values and whether they are presented in a systematic or random manner.

Linear Association

We conducted bivariate correlational analyses (Pearson, two-tailed) with the total factor scores for the construct of the model. IBM-SPSS v. 25 was used for both analyses.

Path Analysis of Exploratory Prediction

Exploratory predictive hypotheses were tested, using path analysis with a mediational model, for multiple measurements (Ato and Vallejo, 2011). For each hypothesis posed, we tested a different empirical model of path analysis (Byrne, 2016). The first two models related to the predictive analysis of *protective factors* (buffers) against academic stress, while the second two focused on the prediction of *risk factors* for academic stress. Models 2 and 4 were selected, because they fulfilled the statistical parameters and responded empirically to the proposed integrative model. We assessed the model fit by first examining the ratio of chi-square to degrees of freedom, then the comparative fit index (CFI), normed fit index (NFI), incremental fit index (IFI), and relative fit index (RFI). All fit measures of the incremental model were above the suggested limit of 0.90 (Bentler, 1990): Comparative fit index (CFI), incremental fit index (IFI), normed fit index (NFI), relative fit index (RFI), and Tucker–Lewis index (TLI). We replicated the results of the original scale. The value of the root mean square error of approximation (RMSEA) was 0.084, less than the warning value of 0.09 (Vázquez et al., 2006). We also used the Hoelter index to determine the adequacy of the sample size. AMOS (v.22) was used for these analyses. Keith (2006) proposed the following beta coefficients as research benchmarks for *direct effects*: <0.05 is considered too small to be meaningful, above.05 is small but meaningful, above.10 is moderate, and above.25 is large. For *indirect effects*, we used the definition of an indirect effect as the product of two effects; using Keith's benchmarks above, we propose a small indirect effect =0.003, moderate =0.01, and large =0.06, values that are significant in the sphere of education.

RESULTS

Preliminary Analyses: Normality Assumptions

The descriptive and normality results showed the fit required for using linear analyses with the variables of the sample. Regarding asymmetry and kurtosis, in most cases, the obtained values were <0.500. As for the Kolmogorov–Smirnoff test, the distribution of values was not significantly different from a normal distribution. See **Table 1**.

Correlations

Protective Factors Against Academic Stress

The personal (presage) factors of *conscientiousness* and *positivity* were found in statistically significant association with different constituent factors of the competency for studying, learning, and performing under stress (process). These characteristic factors of the SLPS competency were also significantly associated among themselves, namely, *deep approach*, *self-regulation*, *problem-focused coping*, *resilience*, *positive achievement emotions*, *engagement*, and *academic behavioral confidence*. These factors, in turn, were negatively associated with stress responses (product), defined as *stress factors of the learning process*, and *stress symptoms*. In complementary fashion, *Regulatory teaching* (presage) was associated positively with certain constituent factors of the SLPS competency and also negatively with *stress factors of the teaching process* (process). See **Table 2**.

Risk Factors of Academic Stress

The personal factor *neuroticism* had a statistically significant, negative association with *positivity* (a presage factor). Also, neuroticism had a statistically significant, positive association with different factors representing a lack of the SLPS competency for learning under stress (process), such as procrastination, burnout, and negative achievement emotions. Factors showing a lack of SLPS competency were also positively associated with one another, such as *surface approach*, *emotion-focused coping*, *negative achievement emotions*, and *burnout*, and were negatively associated with *protective factors*, such as *academic behavioral confidence*, *self-regulation*, and *resilience*. Such risk factors were, in turn, positively associated with stress responses (product), defined as *stress factors of the learning process* and *stress symptoms*. In a complementary fashion, *regulatory teaching* (presage) was associated positively with certain constituent factors of the SLPS competency and also negatively with *stress factors of the teaching process* (process). See **Table 3**.

Path Analysis Predictive Relationships

The four exploratory models that were tested fulfilled the statistical parameters required for the empirical fit (see **Table 3**). From these four models, models 2 and 4 were selected. Despite having somewhat less significance, they showed a better fit to the theoretical model on which this research is based. Model 1 shows statistics of the stress protection factors that refer exclusively to the learning process. Model 2 shows the statistics when teaching process variables are also included; for

TABLE 2 | Distribution and normalization statistics of the sample ($n = 564$).

Variables	Range	Min	Max	Med	(sd)	Asym	Kurtosis	Kolmogorov-Smirnoff
CONSC	1–5	1.83	5.00	3.69	(0.57)	−0.260	0.015	0.192*
NEUROT	1–5	1.00	5.00	2.65	(0.74)	0.225	0.003	0.110*
POSIT	1–5	1.25	5.00	3.76	(0.67)	−0.540	0.403	0.118*
DEEP.LEARN.	1–5	1.00	5.00	2.96	(0.16)	−0.079	0.032	0.115*
SURF.LEARN.	1–5	1.00	5.00	2.16	(0.19)	0.572	0.588	0.116*
SR	1–5	1.21	5.00	3.48	(0.60)	−0.182	−0.157	0.098*
PROCRAST	1–5	1.00	4.06	2.29	(0.65)	0.209	−0.372	0.200*
PROBLC	1–4	1.30	3.95	2.99	(0.41)	−0.342	0.041	0.114*
EMOTC	1–4	1.60	3.97	2.59	(0.30)	0.156	0.318	0.092*
RESIL	1–5	1.82	4.86	3.74	(0.46)	−0.466	0.421	0.200*
EMOTP	1–5	1.15	4.93	3.34	(0.62)	−0.130	0.260	0.200*
EMOTN	1–5	1.06	4.10	2.23	(0.56)	0.476	−0.075	0.200*
CONFIDENCE	1–5	1.00	4.86	3.74	(0.56)	−0.168	−0.016	0.200*
ENGAG	1–5	1.00	5.00	3.47	(0.66)	−0.215	0.302	0.200*
BURN	1–5	1.00	4.78	2.22	(0.17)	0.583	0.018	0.098*
RT	1–5	1.12	5.00	3.68	(0.63)	−0.353	0.058	0.080*
TEACH.STRESS	1–5	1.00	5.00	2.31	(0.71)	0.592	0.033	0.200*
LEARN.STRESS	1–5	1.00	4.70	2.61	(0.75)	0.114	−0.485	0.200*
SYMPTOM.STRESS	1–5	1.00	5.00	2.31	(0.71)	0.592	0.366	0.132*

*CONSC, conscientiousness; NEURO, neuroticism; POSIT, positivity; DEEP.LEARN, deep learning approach; SURF.LEARN., surface learning approach; CONFIDENCE, academic behavioral confidence; SR, self-regulation; PROCRAST, procrastination; PROBLC, problem-focused coping; EMOTC, emotion-focused coping; RESIL, resilience; EMOTP, positive achievement emotions; EMOTN, negative achievement emotions; ENGAG, engagement; BURN, burnout; RT, regulatory teaching; TEACH.STRESS, stress factors of teaching process; LEARN.STRESS, stress factors of learning process; SYMPTOM.STRESS, symptoms of stress. *non-significant statistical differences with the distribution.*

TABLE 3 | Bivariate correlations between *protective factors* against academic stress in this research ($n = 564$).

	CONSC	POSIT	DEEP	SR	PROBC	RESIL	EMOTP	ENGAG	CONF	RT	STRTE	STRLE
CONSC												
POSIT	0.435**											
DEEP	0.518**	0.371**										
SR	0.632**	0.476**	0.371**									
PROBC	0.381**	0.384**	0.293**	0.341**								
RESIL	0.455**	0.500**	0.271**	0.482**	0.414**							
EMOTP	0.633**	0.603**	0.593**	0.551**	0.461**	0.428**						
ENGAG	0.563**	0.407**	0.487**	0.450**	0.356**	0.407**	0.711**					
CONF	0.465**	0.264**	0.478**	0.534**	0.341**	0.500**	0.603**	0.436**				
RT	0.320**	0.307**	0.270**	0.226**	−0.226**	0.236**	0.352**	0.348**	0.307**			
STRTE	−0.118**	−0.342**	−0.142**		−0.063	−0.168**	−0.314**	−0.219**	−0.367**	−0.105**		
STRLE	−0.194**	−0.178**	−0.095*	−0.341**	−0.028	−0.106*	−0.285**	−0.221**	−0.178**	−0.34	0.614**	
STRSY	−0.280**	−0.148**	−0.022	−0.161**	−0.098**	−0.169**	−0.353**	−0.099**	−0.148**	−0.91**	0.442**	0.603**

*CONSC, conscientiousness; POSIT, positivity; DEEP, deep approach; CONF, academic behavioral confidence; SR, self-regulation; PROBC, problem-focused coping; ENGAG, engagement; EMOTP, positive achievement emotions; RESIL, resilience; RT, regulatory teaching; STRTE, stress factors of teaching process; STRLE, stress factors of learning process; STRSY, symptoms of stress. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.*

this reason, it is more powerful, and the statistical values are better fitted. Model 3 refers to risk factors for stress that are triggered by the learning process, while Model 4 incorporates stress factors from the teaching process as well, also showing better a statistical fit (see **Table 4**). We, therefore, present below the specific, predictive statistical values from Models 2 and 4.

The Model of Protective Factors Against Academic Stress (Model 2)

Direct Effects of the Protective Factors

The predictive structural Model 2 demonstrated many predictive relationships pertaining to students. Two *personal factors* (presage) were found to protect against stress: *conscientiousness* and *positivity*. The former significantly predicted the latter

TABLE 4 | Bivariate correlations between *risk factors* of academic stress in this research ($n = 564$).

	NEUROT	POSIT	SURFACE	SR	PROCR	EMOTC	RESIL	EMOTN	BURN	CONF	RT	STRTE	STRLE
NEUROT													
POSIT	−0.325**												
SURFACE	0.188**	−0.173**											
SR	−0.367**	0.472**	−0.360**										
PROCR	0.252**	−0.173**	0.323**	−0.418**									
EMOTC	0.288**	−0.028	0.161**	−0.108**	0.280**								
RESIL	−0.280**	0.592**	−0.170**	0.490**	−0.223**	0.076*							
EMOTN	0.472**	−0.300**	0.455**	−0.479**	0.513**	0.263**	−0.315**						
BURNOUT	0.343**	−0.458**	0.368**	0.491**	0.452**	0.140**	−0.372**	592**					
CONF	−0.243**	0.377**	−0.318**	0.532**	−0.327**	0.012	0.498**	−0.478**	−0.449**				
RT	−0.010	0.307**	−0.134**	0.229**	−0.213**	0.083**	0.242**	−0.186**	−0.270**	0.283**			
STRTE	0.388**	−0.342**	0.348**	−0.317**	0.325**	0.174**	−0.229**	0.583**	0.357**	−0.389**	−0.105*		
STRLE	0.418**	−0.178**	0.250**	−0.351**	0.383**	0.315**	−0.149*	0.612**	0.413**	−0.204**	−0.34	0.612**	
STRSY	0.569**	−0.148**	0.273**	−0.411**	0.341**	0.342**	−0.233**	0.583**	0.357**	−0.389**	−0.084*	0.442**	0.603**

NEUROT, neuroticism; POSIT, positivity; SURFACE, surface approach; CONF, academic behavioral confidence; SR, self-regulation; PROCR, procrastination; EMOTC, emotion-focused coping; RESIL, resilience; EMOTN, negative achievement emotions; BURNOUT, burnout; RT, regulatory teaching; STRTE, stress factors of teaching process; STRLE, stress factors of learning process; STRSY, symptoms of stress. $^*p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

($B = 0.376$). Both were significant predictors of different levels of the SLPS competency components (presage). Conscientiousness, as an "executive" personality variable, appeared as a significant predictor of meta-cognitive variables (deep approach; $B = 0.190$), meta-behavioral variables (self-regulation; $B = 0.438$), meta-emotional variables (problem-focused coping; $B = 0.110$), meta-motivational variables (resilience; $B = 0.090$), and meta-affective variables (academic behavioral confidence; $B = 0.180$), and also of emotional variables (positive emotions; $B = 0.247$). *Positivity*, as a personal psychological variable, appeared as a significant predictor of emotional variables (positive emotions; $B = 0.177$).

The relationships between the factors of the SLPS competency model (process) were also very significant. Thus, *deep learning* predicted academic behavioral confidence ($B = 0.111$). Academic behavioral confidence was predicted by *self-regulation* ($B = 0.121$) and *engagement* ($B = 0.120$). Self-Regulation predicted *academic behavioral confidence* ($B = 0.177$), *resilience* ($B = 0.186$), *engagement* and *positive emotions* ($B = 0.465$). *One* especially important predictive effect was to the predictive power of *positive emotions* with respect to *deep approach* ($B = 0.450$), *academic behavioral confidence* ($B = 0.228$), *self-regulation* (*beta* $= 0.219$), *problem-focused coping* ($B = 0.280$), and *resilience* ($B = 0.118$).

In the analysis of teaching process factors, the positive predictive value of *regulatory teaching* (RT) was demonstrated in regard to *positivity* ($B = 0.11$), *academic behavioral confidence* ($B = 0.068$), *engagement* ($B = 0.207$), and *positive emotions* ($B = 134$). Inversely, *regulatory teaching* negatively predicted the *stress in teaching* factor ($B = -0.115$), which, in turn, negatively predicted *positive emotions* ($B = -0.127$), and positively predicted *stress in learning* ($B = 0.589$).

Different relations were also shown in regard to the prediction of stress symptoms, such as *stress during learning* and *stress symptoms* (product). Some factors were significant negative predictors of *stress in learning*, such as *self-regulation* ($B = -0.171$), and *positive emotions* ($B = -0.175$), but others were positive predictors, like problem-focused coping ($B = 0.069$) and, above all, *stress in teaching* (B =0.589). Finally, *stress symptoms* were negatively predicted by personal factors like *self-regulation* ($B = -0.167$) and *resilience* ($B = -0.143$), but also by *stress in learning* ($B = 0.543$), a factor that was already shown to be predicted by *stress in teaching*.

Indirect Effects of the Protective Factors

The indirect effects showed that some variables had adequate values as mediating predictors. Thus, the variables *conscientiousness* and *positivity* (presage factors) showed a positive effect on nearly all the variables belonging to the SLPS competency—*conscientiousness* having greater predictive strength—and a significant negative predictive effect on the two variables of experiencing academic stress ($B = -0.211$ and $B = -0.119$, respectively).

Second, a group of factors belonging to the SLPS competency (process factors) showed positive, predictive indirect effects among themselves (self-regulation, problem-focused coping, engagement, and positive emotions), and negative effects on *academic stress* ($B = -0.003$; $B = -0.119$; $B = -0.037$; $B = -0.032$; $B = -0.070$). Likewise, *regulatory teaching* had a positive indirect effect on most variables of the SLPS competency (confidence, $B = 0.104$; self-regulation, $B = 0.078$; problem-focused coping, $B = 0.101$; engagement, $B = 0.018$; positive emotions, $B = 0.139$; resilience, $B = 0.097$).

Finally, most of the SLPS variables had a negative indirect predictive effect on *academic stress* (confidence, $B = -0.003$; self-regulation, $B = -0.019$; engagement, $B = -0.032$; positive emotions, $B = -0.037$; resilience, $B = 0.097$), as did regulatory teaching ($B = -0.066$). However, positive indirect prediction

TABLE 5 | Statistical parameters of structural models.

Models	Type of factors	Direction	Chi- square	Degrees of freedom	*p* <	RSMR	TLI	RFI	IFI	TLI	CFI	*RMSEA*	*HO0.05*	*HO0.01*
Model 1	L	Protective factors	184.714	(77–51):26	0.001	0.072	0.948	0.969	0.955	0.958	0.955	0.061	349	409
Model 2	L & T	Protective factors*	414.536	(104–61): 43	0.001	0.051	0.958	0.987	0.969	0.969	0.954	0.066	337	370
Model 3	L	Risk factors	327.258	(90–77): 33	0.001	0.082	0.955	0.952	0.965	0.971	0.953	0.073	240	278
Model 4	L & T	Risk factors*	519.634	(119–69): 50	0.001	0.032	0.958	0.976	0.959	0.975	0.968	0.065	0.315	0.343

*L, learning process; T, teaching process; *selected models.*

factors did appear (problem-focused coping, $B = 0.101$; stress in teaching, $B = 0.323$). See **Table 5** and **Figure 1**.

Combination Factors

Many total effects were combined effects of direct and indirect prediction effects. **Table 5** presents the total, direct, and indirect effects (full and partial mediation effects) of protective factors of students against academic stress. Observe the predictive value of both personal characteristics and teaching process characteristics.

A Model of Risk Factors in Academic Stress (Model 4)

Direct Effects of the Risk Factors

This model gave evidence of two personal factors with predictive weight (*presage factors*). *Neuroticism* had a negative predictive value for *positivity* ($B = -0.304$). Moreover, *neuroticism* showed a positive predictive value for several risk factors that characterize a lack of SLPS competency, such as *surface approach* ($B = 0.208$), *procrastination* ($B = 0.331$), *burnout* ($B = 0.102$) and *negative emotions* ($B = 0.180$). It also showed a negative predictive value on protective factors like *academic behavioral confidence* ($B = -0.231$) and *self-regulation* ($B = -0.188$).

When analyzing the risk factors belonging to the SLPS competency model, we confirmed significant predictive relationships between them. *Surface approach* negatively predicted *academic behavioral confidence* ($B = -0.164$) and *self-regulation* ($B = -0.266$), and positively predicted *negative emotions* ($B = 0.243$). *Procrastination* negatively predicted self-regulation ($B = -0.129$) and positively predicted *emotion-focused coping* ($B = 0.170$), *burnout* ($B = 0.208$) and *negative emotions* ($B = 0.237$). Also, *emotion-focused coping* and *burnout* predicted *negative emotions* ($B = 0.160$; $B = 0.196$, respectively).

As for context factors, *regulatory teaching* appeared as a protective factor that, in addition to positively predicting protective factors like *positivity* ($B = 0.220$), *academic behavioral confidence* ($B = 0.144$) and *self-regulation* ($B = 0.107$), it negatively predicted risk factors like *procrastination* ($B = -0.111$), *burnout* ($B = -0.116$) and *stress in teaching* ($B = -0.100$). However, the risk factor *stress in teaching* positively predicted *stress in learning* ($B = 0.391$).

Finally, the risk factors of the SLPS competency predicted experiences of academic stress. *Negative emotions* predicted *stress in learning* ($B = 0.163$). *Procrastination* ($B = 0.185$) and *stress in teaching* ($B = 0.391$), as risk factors, positively predicted *stress symptoms. Stress in learning* positively predicted *stress symptoms* ($B = 0.487$). By contrast, protective factors like *self-regulation* ($B = -0.142$) and *resilience* ($B = -0.131$) negatively predicted stress experiences.

Indirect Effects of the Risk Factors

Neuroticism, as a personal risk factor (presage), showed numerous indirect effects that positively predicted risk factors of the SLPS competency, such as *emotion-focused coping* ($B = 0.057$), *burnout* ($B = 0.231$) and *negative emotions* ($B = 0.239$). In addition, its indirect effects negatively predicted protective factors like *academic behavioral confidence* ($B = -0.238$), *self-regulation* ($B = -0.189$) and *resilience* ($B = -0.267$).

Regarding risk factors of the SLPS competency (*process factors*), certain risk factors (*surface approach* and *procrastination*) showed the indirect effect of positively predicting other risk factors (*emotion-focused coping, burnout,* and *negative emotions).* The opposite occurred with personal protective factors (*academic behavioral confidence* and *self-regulation*) and contextual protective factors (*regulatory teaching*), where risk factors were negatively predicted (*burnout* and *negative emotions*).

Finally, there was an indirect effect that positively predicted *stress symptoms* (*product* factor): from *neuroticism* (a *presage* factor), *surface approach*, *procrastination*, *burnout*, *negative emotions*, and *stress in teaching* (*process* factors). Protective factors like *positivity* (*presage* factor), *academic behavioral confidence*, *self-regulation*, *resilience*, and *regulatory teaching* (*process* factors) appeared as negative predictors of *stress symptoms* (a *product* factor). See **Table 6** and **Figure 3**.

Combination Factors

In this model, many total effects were also combined effects of direct and indirect prediction effects. **Table 7** presents the total, direct, and indirect effects (full and partial mediation effects) of risk factors of students for academic stress. Observe the predictive value of both personal characteristics and teaching process characteristics.

DISCUSSION

In general, the results support the established hypotheses in various aspects. Regarding Hypothesis 1, certain personality factors (*conscientiousness* and *positivity*) demonstrated their protective function against stress by positively and directly predicting the behaviors that make up the SLPS

TABLE 6 | Total, indirect, and direct effects of *stress protection factors* in this study, and 95% bootstrap confidence intervals (CI).

Predictive variable	Criterion variable	Total effect	CI (95%)	Direct effect	CI (95%)	Indirect effect	CI (95%)	Results, effects	CI (95%)
CONSC–>	Positivity	0.376	[0.32, 0.43]	0.376	[0.32, 0.43]	0.00	[−0.03, 0.04]	Direct only	[0.32, 0.43]
CONSC—>	Deep Appr	0.440	[0.48, 0.39]	0.190	[0.16, 0.23]	0.248	[0.20, 0.28]	Partial mediat	[0.20, 0.28]
CONSC–>	Self-Regul	0.621	[0.59, 0.72]	0.438	[0.41, 0.56]	0.183	[0.11, 0.25]	Partial mediat	[0.11, 0.25]
CONSC–>	Problem coping	0.348	[0.29, 0.40]	0.110	[0.06, 0.16]	0.238	[0.18, 0.29]	Partial mediat	[0.18, 0.29]
CONSC–>	Resilience	0.444	[0.41, 0.48]	0.090	[0.02, 0.14]	0.354	[0.29, 0.39]	Full mediation	[0.39, 0.29]
CONSC–>	Posit. emot	0.551	[0.50, 0.61]	0.247	[0.16, 0.32]	0.304	[0.20, 0.40]	Partial mediat	[0.20, 0.40]
CONSC–>	Acad. confid	0.513	[0.62, 0.40]	0.180	[0.12, 0.23]	0.333	[0.29, 0.39]	Partial mediat	[0.29, 0.39]
CONSC–>	Engagement	0.511	[0.39, 0.62]	0.458	[0.34, 0.56]	0.053	[0.01, 0.09]	Direct only	[0.34, 0.56]
CONSC–>	Regul. Teach	0.00		0.00		0.00		Non-effect	
CONSC–>	Stress Teach	0.00		0.00		0.00		Non-effect	
CONSC–>	Stress Learn	−0.083	[−0.02, 13]	0.00	[−0.04, 0.07]	−0.083	[−0.02, 13]	Full mediation	[−0.02, 13]
CONSC–>	Stress Sympt	−0.211	[−0.17, −0.24]	0.00	[−0.05, 0.08]	−0.211	[−0.17, −0.24]	Full mediation	[−0.17, −0.24]
Positivity–>	Deep Appr	0.084	[0.02, 15]	0.00	[−0.03, 05]	0.084	[0.02, 15]	Partial mediat	[0.02, 15]
Positivity–>	Self-Regul	0.041	[0.01, 0.09]	0.00	[−0.01, 04]	0.041	[0.01, 0.09]	Partial mediat	[0.01, 0.09]
Positivity–>	Probl. coping	0.053	[−0.03, 0.11]	0.00	[−0.03, 07]	0.053	[−0.03, 0.011]	Partial mediat	[−0.03, 0.011]
Positivity–>	Resilience	0.061	[0.01, 0.11]	0.00	[−0.04, 09]	0.061	[0.01, 0.11]	Partial mediat	[0.01, 0.11]
Positivity–>	Posit. emot	0.177	[0.10, 0.26]	0.177	[0.10, 0.26]	0.00	[−0.04, 0.06]	Direct only	[0.10, 0.26]
Positivity->	Acad. confi	0.089	[0.01, 14]	0.00	[−0.03, 0.05]	0.089	[0.01, 14]	Only indirect	[0.01, 14]
Positivity->	Engagement	0.023	[−0.02, 06]	0.00	[−0.06, 0.07]	0.023	[−0.02, 06]	Only indirect	[−0.02, 06]
Positivity->	Regul teach	0.00		0.00		0.00		Non-effect	
Positivity->	Stress Teach	0.00		0.00		0.00		Non-effect	
Positivity->	Stress Learn	0.00		0.00		0.00		Non-effect	
Positivity->	Stress Sympt	−0.117	[−0.19, −0.05]	0.00	[−0.04, 0.07]	−0.117	[−0.19, −0.05]	Only indirect	[−0.19, −0.05]
Deep Learning–>	Self-Regul.	0.001		0.00		0.001	[−0.010, −0.005]	Only indirect	[−0.010, −0.005]
Deep Learning–>	Probl. coping	0.053	[−0.07, −0.03]	0.00	[−0.03, 0.05]	0.053	[−0.07, −0.03]	Only indirect	[−0.07, −0.03]
Deep Learning–>	Resilience	0.001	[−0.09, −0.003]	0.00	[−0.06, 0.09]	0.001	[−0.09, −0.003]	Only indirect	[−0.09, −0.003]
Deep Learning–>	Posit. emot	0.005	[0.23, 0.78]	0.00	[−0.04, 0.07]	0.005	[0.001, 0.008]	Only direct	[0.23, 0.78]
Deep Learning—>	Acad. confi	0.113	[0.08, 0.14]	0.111	[0.08, 0.14]	0.002	[0.001, 0.007]	Only indirect	[0.08, 0.14]
Deep Learning–>	Engagement	0.012	[0.06, 0.015]	0.00	[−0.03, 0.05]	0.012	[0.06, 0.015]	Only indirect	[0.06, 0.015]
Deep Learning–>	Regul teach							Non-effect	
Deep Learning–>	Stress Teach							Non-effect	
Deep Learning–>	Stress Learn	−0.017	[−0.012, −0.026]	0.00	[−0.04, 0.07]	−0.017	[−0.012, −0.026]	Only indirect	[−0.012, −0.026
Deep Learning–>	Stress Sympt							Non-effects	
Self-regulation–>	Probl coping	0.002	[−0.001, 0.006]	0.00	[−0.06, 0.04]	0.002	[−0.001, 0.006]	Only indirect	[−0.001, 0.006]
Self-regulation–>	Resilience	0.188	[0.154, 0.213]	0.186	[0.154, 0.213]	0.002	[−0.001, 0.005]	Only direct	[0.154, 0.213]
Self-regulation–>	Posit. emot	0.228	[0.110, 0.267]	0.219	[0.111, 0.258]	0.009	[0.001, 0.018]	Only direct	[0.111, 0.258]
Self-regulation–>	Acad. confi	0.180	[0.201, 0.165]	0.177	[0.182, 163]	0.003	[−0.001, 0.004]	Only direct	[0.182, 163]
Self-regulation–>	Engagement	0.019	[0.09, 0.26]	0.00	[−0.05, 0.08]	0.019	[0.09, 0.26]	Full mediation	[0.09, 0.26]
Self-regulation–>	Regul teach							Non-effect	
Self-regulation–>	Stress Teach	−0.159	[−0.087, −0.23]	0.00	[−0.05, 0.08]	−0.159	[−0.087, −0.23]	Full mediation	[−0.087, −0.23]

(Continued)

TABLE 6 | Continued

Predictive variable	Criterion variable	Total effect	CI (95%)	Direct effect	CI (95%)	Indirect effect	CI (95%)	Results, effects	CI (95%)
Self-regulation–>	Stress Learn	−0.173	[−0.08, −0.24]	−0.173	[−0.08, −0.24]	0.00		Only direct	
Self-regulation–>	Stress Sympt	−0.288	[−0.145, −0.316]	−0.167	[−0.134, −0.186]	−0.119	[−0.090, −0.134]	Partial mediat	[−0.090, −0.134]
Problem coping–>	Resilience							Non-effect	
Problem coping–>	Posit. emot	0.280	[0.127, 0.348]	0.280	[0.127, 0.348]	0.00	[−0.03, 08]	Only direct	[0.127, 0.348]
Problem coping–>	Acad. confi	0.014	[0.03, 0.031]	0.00	[−0.06, 0.09]	0.014	[0.03, 0.031]	Full mediation	[−0.06, 0.036
Problem coping–>	Engagement							Non-effect	
Problem coping–>	Regul teach							Non-effect	
Problem coping–>	Stress Teach							Non-effect	
Problem coping–>	Stress Learn	0.069	[0.043, 0.075]	0.069	[0.043, 0.075]	0.00	[−0.04, 0.09]	Direct only	[0.043, 0.075]
Problem coping–>	Stress Sympt	0.037	[0.021, 0.048]	0.00	[−0.06, 0.07]	0.037	[0.021, 0.48]	Partial mediat	[0.021, 0.48]
Resilience–>	Posit. emot	0.161	[0.132, 0.184]	0.118	[0.07, 0.28]	0.043	[0.018, 0.056]	Partial mediat	[0.018, 0.056]
Resilience–>	Acad. confi	0.008	[0.003, 0.010]	0.00	[−0.07, 0.08]	0.008	[0.003, 0.010]	Full mediation	[0.003, 0.010]
Resilience–>	Engagement							Non-effect	
Resilience–>	Regul teach							Non-effect	
Resilience–>	Stress Teach	−0.140	[−0.11, −0.23]	0.00	[−0.033, 0.04]	−0.140	[−0.124, −0.231]	Full mediation	[−0.124, −0.231]
Resilience–>	Stress Learn							Non-effect	
Resilience–>	Stress Sympt	−0.141	[−0.10, −0.24]	−0.141	[−0.10, −0.24]	0.00	[−0.04, 0.06]	Direct only	[−0.10, −0.24]
Posit. emot–>	Deep Appr	0.450	[0.65, 23]	0.450	[0.65, 23]	0.00	[−0.06, 0.10]	Direct only	[0.65, 23]
Posit. emot–>	Acad. confi	0.228	[0.12, 0.39]	0.228	[0.12, 0.39]	0.093	[0.01, 0.016]	Partial mediat	[0.12, 0.39]
Posit. emot–>	Engagement	0.033	[0.01, 0.05]	0.00	[−0.04, 0.06]	0.033	[−0.01, 0.06]	Full mediation	[0.01, 0.05]
Posit. emot–>	Regul teach							Non-effect	
Posit. emot–>	Stress Teach							Non-effect	
Posit. emot–>	Stress Learn	−0.175	[−0.078, −0.213]	−0.175	[−0.078, −0.213]	−0.019	[−0.007, −0.034]	Partial mediat	[−0.007, −0.034]
Posit. emot—>	Stress Sympt	−0.070	[−0.050, −0.096]	0.00	[−0.04, 0.07]	−0.070	[−0.050, −0.096]	Only indirect	[−0.050, −0.096]
Academic conf—>	Self–Regul	0.132	[0.007, 0.221]	0.121	[0.10, 0.21]	0.011	[−0.003, 0.022	Only directr	[0.10, 0.21
Academic conf—>	Engagement	0.106	[0.095, 0.122]	0.104	[0.095, 0.125]	0.002	[−0.001, 0.003]	Partial mediat	[−0.001, 0.003]
Academic conf—>	Regul teach							Non-effect	
Academic conf—>	Stress Teach							Non-effect	
Academic conf—>	Stress Learn	−0.001	[−0.03, −0.005]	0.00	[−0.003, 0.006]	−0.001	[−0.03, −0.005]	Full mediation	[−0.03, −0.005]
Academic conf—>	Stress Sympt	−0.003	[−0.07, −0.004]	0.00	[−0.05, 0.07]	−0.003	[−0.07, −0.004]	Full mediation	[−0.07, −0.004]
Engagement—>	Deep Appr	0.213	[0.198, 0.314]	0.00	[−0.03, 0.08]	0.213	[0.198, 0.314]	Full mediation	[0.198, 0.314]
Engagement—>	Self–Reg	0.103	[0.086, 0.121]	0.00	[−0.01, 0.04]	0.103	[0.086, 0.121]	Full mediation	[0.086, 0.121]
Engagement—>	Probl.coping	0.132	[0.084, 0.142]	0.00	[−0.09, 0.07]	0.132	[0.084, 0.142]	Full mediation	[0.084, 0.142]
Engagement—>	Resilience	0.075	[0.053, 0.092]	0.00	[−0.04, 0.03]	0.075	[0.053, 0.092]	Full mediation	[0.053, 0.092]
Engagement—>	Posit. emot	0.465	[0.33, 0.57]	0.465	[0.33, 0.57]	0.007	[−0.002, 0.015]	Direct only	[0.33, 0.57]
Engagement—>	Acad. confi	0.149	[0.087, 0.235]	0.00	[−0.01, 0.05]	0.149	[0.087, 0.235]	Full mediation	[0.087, 0.235]
Engagement—>	Regul teach							Non-effect	
Engagement—>	Stress Teach							Non-effect	
Engagement—>	Stress Learn	−0.009	[−0.012, −0.003]	0.00	[−0.004, 0.007]	−0.009	[−0.012, −0.003]	Full mediation	[−0.012, −0.003]

(Continued)

TABLE 6 | Continued

Predictive variable	Criterion variable	Total effect	CI (95%)	Direct effect	CI (95%)	Indirect effect	CI (95%)	Results, effects	CI (95%)
Engagement—>	Stress Symt	−0.032	[−0.041, −0.018]	0.00	[−0.03, 0.07]	−0.032	[−0.041, −0.018]	Full mediation	[−0.041, −0.018]
Regul. Teach—>	Positivity	0.110	[0.08, 0.13]	0.110	[0.08, 0.13]	0.00	[−0.04, 0.05]	Direct only	[0.08, 0.13]
Regul. Teach—>	Deep Learn							Non-effect	
Regul. Teach—>	Self–Reg	0.078	[0.031, 0.093]	0.00	[−0.02, 0.06]	0.078	[0.031, 0.093]	Full mediation	[0.031, 0.093]
Regul. Teach—>	Prob.coping	0.101	[0.087, 0.145]	0.00	[−0.04, 0.07]	0.101	[0.087., 0.145]	Full mediation	[0.087., 0.145]
Regul. Teach—>	Resilience	0.097	[0.05, 0.123]	0.00	[−0.03, 0.07]	0.097	[0.05, 0.123]	Full mediation	[05, 0.123]
Regul. Teach—>	Posit. emot	0.271	[0.210, 0.321]	0.134	[0.084, 0.238]	0.139	[0.075, 0.216]	Partial mediat	[0.075, 0.216]
Regul. Teach—>	Acad. confi	0.172	[0.113, 0.195]	0.068	[0.032, 0.89]	0.104	[0.87, 0.135]	Partial mediat	[0.87, 0.135]
Regul. Teach—>	Engagement	0.225	[0.118, 0.236]	0.207	[0.196, 0.236]	0.018	[0.07, 0.26]	Partial mediat	[0.07, 0.26]
Regul. Teach—>	Stress Teach	−0.115	[−0.131, −0.108]	−0.115	[−0.131, −0.108]	0.00	[−0.02, 0.08]	Direct only	[−0.131, −0.108
Regul. Teach—>	Stress Learn	−0.074	[−0.043, 0.094]	0.00	[−0.06, 05]	−0.074	[−0.043, 0.094]	Full mediation	[−0.043, 0.094]
Regul. Teach—>	Stress Sympt	−0.066	[−0.090, −0.01]	0.00	[−0.02, 0.05]	−0.066	[−0.090, −0.01]	Full mediation	[−0.090, −0.01]
Stress Teach—>	Positivity							Non-effect	
Stress Teach—>	Deep Learn	−0.058	[−0.08, 0.02]	0.00	[−0.05, 0.03]	−0.058	[−0.08, 0.02]	Full mediation	[−0.08, 0.02]
Stress Teach—>	Self–Reg	−0.028	[−0.07, 0.03]	0.00	[0.−04, 0.08]	−0.028	[−0.07, 0.03]	Full mediation	[−0.07, 0.03]
Stress Teach—>	Prob. coping	−0.036	[−0.24, 0.67]	0.00	[−0.03, 08]	−0.036	[−0.24, 0.67]	Full mediation	
Stress Teach—>	Resilience	−0.020	[−0.034, −0.08]	0.00	[−0.03, 0.12]	−0.020	[−0.034, −0.08]	Full mediation	[−0.034, −0.08]
Stress Teach—>	Posit. emot	−0.127	[−0.132, −0.111]	−0.127	[−0.132, −0.111]	0.00	[−0.03, 0.08]	Direct only	[−0.132, −0.111]
Stress Teach—>	Acad. confi	−0.041	[−0.021, 0.054]	0.00	[−0.06, 0.07]	−0.041	[−0.021, 0.054]	Full mediation	[−0.021, 0.054]
Stress Teach—>	Engagement	−0.004	[−0.007, 0.003]	0.00	[−0.08, 0.06]	−0.004	[−0.007, 0.003]	Full mediation	[−0.007, 0.003]
Stress Teach—>	Stress Learn	0.561	[0.438, 0.649]	0.589	[0.438, 0.749]	0.002	[−0.003, 0.005]	Direct only	[0.438, 0.649]
Stress Teach—>	Stress Sympt	0.323	[0.225, 0.426]	0.00	[−0.002, 0.012]	0.323	[0.225, 0.426]	Full mediation	[0.225, 0.426]
Stress Learn—>	Stress Teach	0.529	[0.423, 0.721]	0.00	[−0.05, 0.10]	0.529	[0.423, 0.721]	Full mediation	[0.423, 0.721]
Stress Learn—>	Stress Sympt	0.534	[0.213, 0.678]	0.534	[0.213, 0.678]	0.00	[−0.021, 0.045]	Direct only	[0.213, 0.678]

Bootstrapping sample size = 564. Model 2 (teaching and learning factors).

CONSC, conscientiousness; deep learning, deep approach; Acad. confi, academic behavioral confidence; Self-Reg, self-regulation; Prob. coping, problem-focused coping; Posit. emot, positive achievement emotions; Regul. Teach, regulatory teaching; Stress Teach, stress factors of teaching process; Stress Learn, stress factors of learning process; Stress Sympt, symptoms of stress; CI, confidence interval. Bootstrapping sample size = 430.

competency, and negatively and indirectly predicting stress levels. This result concurs with previous research that asserted the factors of *conscientiousness* and *positivity* as *personal factors that protect against stress* (Caprara and Steca, 2005; Caprara et al., 2017; Greene et al., 2020) and as predictors of adequate learning processes (Biggs, 1970b). Previous evidence showed a positive, partially predictive relationship between different factors of the SLPS competency and the variables of deep approach, academic behavioral confidence, problem-focused coping (Leszko et al., 2020), positive emotions, and resilience (de la Fuente et al., 2017a, 2019b).

It is of great interest that behaviors that are inherent in the SLPS competency, according to its model (de la Fuente, 2015a), prove to be associated with and to predict each other, forming clusters of protective (*buffering*) and risk factors. This has revealed the existence of a group of *protective factors* against stress, such as the deep approach, which has a positive linear relationship with academic behavioral confidence, self-regulation, positive achievement emotions, engagement, and resilience, in line with what was reported in previous research (Quoidbach et al., 2010; Artuch-Garde et al., 2017; de la Fuente et al., 2021f). This reflects a clear associative relationship between the metacognitive, meta-behavioral, meta-motivational,

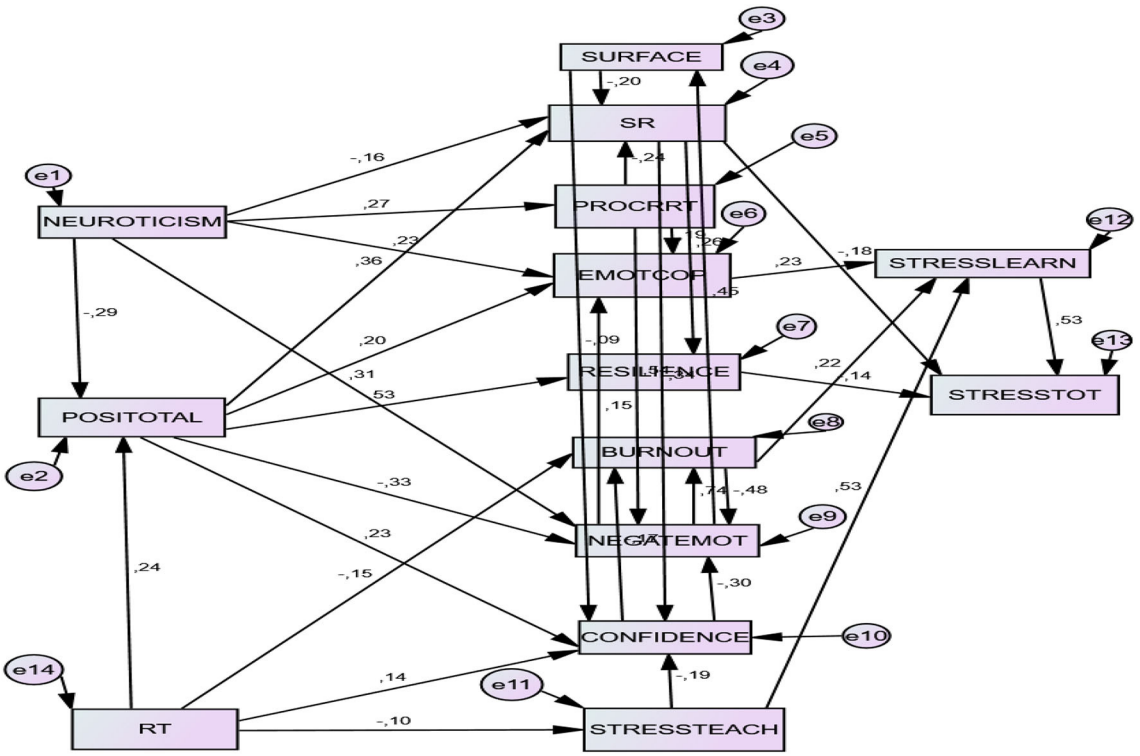

FIGURE 3 | A structural predictive model of risk factors for academic stress (Model 4). POSITOTAL, positivity; SURFACE, surface approach; CONFIDENCE, academic behavioral confidence; SR, self-regulation; PROCRRT, procrastination; EMOTCOP, emotion-focused coping; NEGATEMOT, negative achievement emotions; RT, regulatory teaching; STRESSTEACH, stress factors of teaching process; STRESSLEARN, stress factors of learning process; STRESSTOT, symptoms of stress; CI, confidence interval. Bootstrapping sample size = 430.

emotional, and attitudinal variables of learning, when learning takes place under conditions of university academic stress. These variables have been traditionally separated in their effects and their analyses—just as what is espoused by the SLPS competency model. Finally, the above variables were found to negatively predict, both directly and indirectly, the factors of *stress in learning* and *stress symptoms* in a manner consistent with the previous evidence (Alias et al., 2020).

Hypothesis 2 has also been confirmed since *regulatory* or *effective teaching* directly predicted personal *positivity*, as well as various protective factors of the SLPS competency, such as academic behavioral confidence, engagement, and achievement emotions, as seen in previous research (Baeten et al., 2010). But it is also interesting to note that such teaching also negatively predicted the factor *stress in teaching*, which would lead to a direct negative prediction of *stress in learning*, also established by previous research (de la Fuente and Justicia, 2003). In other words, *regulatory teaching* would indirectly and inversely predict the factor *stress in learning* and, consequently, stress symptoms. This result is consistent with previous research that also established causal factors of stress in the teaching process, and it provides empirical support for the SRL vs. ERL theory (de la Fuente et al., 2020a,c,d,f).

The assumptions of Hypothesis 3 were also empirically supported by our results. The personal factor *neuroticism* was confirmed as a personal risk factor since it minimizes *positivity* (Greene et al., 2020), as well as protective factors of the SLPS competency, such as academic behavioral confidence, self-regulation, and resilience (McDonnell and Semkovska, 2020). *Neuroticism* is also a positive predictor of the risk factors analyzed here, such as surface approach, procrastination, burnout, and negative achievement emotions, as supported by abundant prior evidence (Chen et al., 2020; Yang et al., 2020). In addition, a positive linear relationship between risk factors of the SLPS competency has been demonstrated. Thus, surface approach was shown to be connected through association and prediction to a lack of *academic behavioral confidence* and *self-regulation* (de la Fuente et al., 2013) and to the use of *emotion-focused coping strategies, burnout, negative achievement emotions*, and a lack of *resilience* (de la Fuente et al., 2017b). Therefore, this positive linear connection between meta-cognitive, meta-affective, meta-motivational, emotional, and attitudinal risk factors could be considered a *cluster of risk* for experiencing academic stress, since all of them positively predict *stress in learning* and *stress symptoms*. Despite these results, some authors have defended the potential of stress during university learning (Rudland et al., 2019).

TABLE 7 | Total, indirect, and direct effects of *stress risk factors* in this study, and 95% bootstrap confidence intervals (CI).

Predictive variable	Criterion variable	Total effect	CI (95%)	Direct effect	CI (95%)	Indirect effect	CI (95%)	Results, effects	CI (95%)
Neuroticism—>	Positivity	−0.304	[−0.43, −0.23]	−0.304	[−0.43, −0.23]	0.00	[−0.03, 0.04]	Direct only	[−0.43, −0.23
Neuroticism—>	Surf. Learn.	0.208	[0.18, 0.29]	0.208	[0.18, 0.29]	0.00	[−0.04, 0.08]	Direct only	[0.18, 0.29]
Neuroticism—>	Self–Regulation	−0.377	[−0.54, −0.22]	−0.188	[−0.24, −0.10]	−0.189	[−0.24, −0.10]	Partial mediation	[−0.24, −0.10]
Neuroticism—>	Procrastinat	0.331	[0.121, 0.546]	0.331	[0.121, 0.546]	0.00	[−0.08, 0.012	Direct only	[0.121, 0.546]
Neuroticism—>	Emo. Coping	0.057	[0.02, 0.08]	0.00	[−0.03, 0.05]	0.057	[0.02, 0.08]	Partial mediation	[0.02, 0.08]
Neuroticism—>	Resilience	−0.267	[−0.41, −0.17]	0.00	[−0.04, 0.07]	−0.267	[−0.271, −0.232]	Full mediation	[−0.271, −0.232]
Neuroticism—>	Negat.Emot	0.419	[0.56, 0.27]	0.180	[0.12, 0.31]	0.239	[0.247, 0.223]	Partial mediation	[0.247, 0.223]
Neuroticism—>	Acad. confi	−0.476	[−0.572, −321]	−0.238	[−321, −0.212]	−0.238	[−0.241, −0.221]	Partial mediation	[−0.241, −0.221]
Neuroticism—>	Burnout	0.333	[0.442, 0.223]	0.102	[0.198, 0.08]	0.231	[0.242, 0.223]	Partial mediation	[0.242, 0.223]
Neuroticism–>	Regul. Teach	0.00		0.00		0.00		Non-effect	
Neuroticism–>	Stress Teach	0.00		0.00		0.00		Non-effect	
Neuroticism–>	Stress Learn	0.202	[0.234, 0.210]	0.00	[−0.03, 0.07]	0.202	[0.234, 0.210]	Full mediation	[0.234, 0.210]
Neuroticism–>	Symt. Stres	0.248	[0.229, 0.259]	0.00		0.248	[0.229, 0.259]	Full mediation	[0.229, 0.259]
Positivity—>	Surf. Learn	00		0.00		0.00		Partial mediat	[0.20, 0.28]
Positivity—>	Self–Regulation	0.300	[0.342, 0.232]	0.300	[0.342, 0.232]	0.00	[−0.05, 0.09]	Direct only	[0.342, 0.232]
Positivity—>	Procrastinat	0.00		0.00		0.00		Non-effect	
Positivity—>	Emot.coping	0.228	[0.325, 0.438]	0.228	[0.325, 438]	0.00	[−0.02, 0.08]	Direct Only	[0.325, 0.438]
Positivity–>	Resilience	0.523	[0.55, 0.50]	0.523	[0.55, 0.50]	0.086	[−0.92,−0.71]	Partial mediation	[−0.92,−0.71]
Positivity–>	Negat. Emot	−0.176	[−0.234, −0.156]	−0.148	[−0.159, −0.129]	−0.028	[−0.010, −0.038]	Partial mediat	[−0.010, −0.038]
Positivity–>	Acad. confi	0.350	[0.382, 0.338]	0.248	[0.267, 0.224]	0.102	[0.95, 0.134]	Partial mediat	[0.95, 0.134]
Positivity–>	Burnout	−0.141	[−0.162, −0.128]	0.00	[−0.03, 0.04]	−0.141	[−0.162, −0.128]	Full mediat	[−0.162, −0.128]
Positivity–>	Regul Teach	0.00		0.00		0.00		Non-effect	
Positivity–>	Stress Teach	0.00		0.00		0.00		Non-effect	
Positivity–>	Stress Learn	0.00	[−0.03, 0.05]	0.00	[−0.03, 0.05]	−0.034	[−0.054, −0.021]	Full mediat	[−0.054, −0.021]
Positivity–>	Stress Symt	−0.139	[−0.145, −0.121]	0.00	[−0.05, 0.06]	−0.139	[−0.145, −0.121]	Full mediat	[−0.145, −0.121]
Surf Learning—>	Self–Regulation	−0.266	[−0.24, −0.21]	−0.266	[−0.24, −0.21]	0.00	[−0.03, 0.07]	Direct only	[−0.24, −0.21]
Surf Learning—>	Procrastinat	0.00		0.00		0.00		Non-effect	0.00
Surf Learning—>	Emo. coping	0.048	[0.025, 0.065]	0.00	[−0.04, 0.07]	0.048	[0.025, 0.065]	Full mediat	[0.025, 0.065]
Surf Learning—>	Resilience	−0.076	[−0.093, −0.034]	0.00	[−0.05, 0.06]	−0.076	[−0.093, −0.034]	Full mediat	[−0.093, −0.034]
Surf Learning—>	Negat. Emot	0.243	[0.27, 0.35]	0.243	[0.27, 0.35]	0.054	[0.012, 0.087]	Partial mediat	[0.012, 0.087]
Surf Learning—>	Acad. confi	−0.254	[−0.351, −0.125]	−0.164	[−0.267, −0.086]	−0.090	[−056. −0.134]	Partial mediat	[−056. −0.134]
Surf Learning—>	Burnout	0.271	[0.197, 0.345]	0.166	[0.067, 0.256]	0.111	[0.065, 0.231]	Partial mediat	[0.065, 0.231]
Surf Learning—>	Regul teach							Non-effect	
Surf Learning—>	Stress Teach							Non-effect	
Surf Learning—>	Stress Learn	0.119	[0.056, 0.123]	0.00	[−0.023, 0.031]	0.119	[0.056, 0.123]	Full mediat	[0.056, 0.123]
Surf Learning—>	Stress Symt	0.106	[0.032, 0.145]	0.00	[−0.011, 0.019]	0.106	[0.032, 0.145]	Full mediat	[0.032, 0.145]

(Continued)

TABLE 7 | Continued

Predictive variable	Criterion variable	Total effect	CI (95%)	Direct effect	CI (95%)	Indirect effect	CI (95%)	Results, effects	CI (95%)
Self–regulation—>	Procrastinat	−0.182	[−0.221, −0.126]	−0.182	[−0.221, −0.126]	0.00	[−0.012, 0.034]	Direct only	[−0.221, −0.126]
Self–regulation—>	Emot coping	−0.008	[−0.001, −0.032]	0.00	[−0.032, 0.134]	−0.008	[−0.001, −0.032]	Partial mediat	[−0.001, −0.032]
Self–regulation—>	Resilience	0.208	[0.325, 0.112]	0.208	[0.325, 0.112]	0.00	[−0.0.04, 0.06]	Direct only	[0.325, 0.112]
Self–regulation—>	Negat. emot							Non-effect	
Self–regulation—>	Acad. confi	0.340	[0.410, 0.225]	0.340	[0.410, 0.225]	0.00	[−0.03, 0.05]	Direct only	[0.410, 0.225
Self–regulation—>	Burnout	−0.084	[−0.012, −0.023]	0.00	[−0.02, 0.08]	−0.084	[−0.012, −0.023]	Full mediat	[−0.012, −0.023]
Self–regulation—>	Regul teach							Non-effect	
Self–regulation—>	Stress Teach							Non-effect	
Self–regulation—>	Stress Learn	−0.021	[−0.032. −0.051	0.00	[−0.04, 0.06]	−0.021	[−0.032. −0.051]	Full mediat	[−0.032. −0.051
Self–regulation—>	Stress Symt	−0.190	[−0.071, 0.224]	−0.142	[−0.243, −0.097]	−0.048	[−0.067, −0.032]	Partial mediat	[−0.067, −0.032]
Procrastination—>	Self–Regul.	−0.129	[−0.023, −0.229]	−0.129	[−0.023, −0.229]	0.00	[−0.012, 0.232]	Direct only	[−0.012, 0.232]
Procrastination—>	Emo. coping	0.217	[0.145, 0.324]	0.170	[0.070, 0.231]	0.047	[−0.02, 0.09]	Partial mediat	[−0.02, 0.09]
Procrastination—>	Resilience	−0.037	[−0.010, −0.32]	0.00	[−0.04, 0.06]	−0.037	[−0.010, −0.32]	Full mediation	[−0.010, −0.32]
Procrastination—>	Negat. Emot	0.284	[0.123, 0.326]	0.237	[0.123, 0.321]	0.047	[0.012, 056]	Partial mediat	[0.012, 056]
Procrastination—>	Acad. confid	−0.044	[−0.021, −0.56]	0.00	[−0.01, 0.07]	−0.044	[−0.021, −0.56]	Full mediat	[−0.021, −0.56]
Procrastination—>	Burnout	0.242	[0.146, 0.356]	0.208	[0.116, 0.267]	0.034	[0.012, 0.045]	Partial mediat	[0.012, 0.045]
Procrastination—>	Regul teach							Non-effect	
Procrastination—>	Stress Teach							Non-effect	
Procrastination—>	Stress Learn	0.142	[0.045, 0.234]	0.00	[−0.04, 0.07]	0.142	[0.045, 0.234]	Full mediat	[0.045, 0.234]
Procrastination—>	Stress Symt	0.277	[0.121, 334]	0.185	[0.113, 0.279]	0.092	[0.04, 23]	Partial mediat	[0.04, 23]
Emotion coping—>	Resilience							Non-effect	
Emotion coping—>	Negat. Emot	160	[0.131, 0.210]	0.160	[0.131, 0.210]	00.	[−0.02, 0.08]	Direct only	[0.131, 0.210]
Emotion coping—>	Acad. confi							Non-effect	
Emotion coping—>	Engagement							Non-effect	
Emotion coping—>	Regul teach							Non-effect	
Emotion coping—>	Stress Teach							Non-effect	
Emotion coping—>	Stress Learn							Non effect	
Emotion coping—>	Stress Symt	0.078	[0.021, 0.123]	0.00	[−0.021, 0.24]	0.078	[0.021, 0.123]	Full mediat	[0.021, 0.123]
Resilience—>	Posit. emot							Non-effect	
Resilience—>	Acad. confi							Non-effect	
Resilience—>	Engagement							Non-effect	
Resilience—>	Regul teach							Non-effect	
Resilience—>	Stress Teach							Non-effect	
Resilience—>	Stress Learn							Non-effect	
Resilience—>	Stress Sympt	−0.262	[−0.123, −0.312]	−0.131	[−0.02, 0.24]	−0.131	[−0.02, −0.24]	Part mediat	[−0.02, −0.24]
Negat. emot—>	Acad. confi							Non-effect	
Negat. emot—>	Burnout	0.026	[−0.03, 0.056]	0.00	[−0.04, 0.07]	0.026	[−0.03, 0.056]	Full mediat	[−0.03, 0.056]
Negat. emot—>	Regul teach							Non-effect	
Negat. emot—>	Stress Teach							Non-effect	

(Continued)

TABLE 7 | Continued

Predictive variable	Criterion variable	Total effect	CI (95%)	Direct effect	CI (95%)	Indirect effect	CI (95%)	Results, effects	CI (95%)
Negat. emot—>	Stress Learn	0.163	[0.114, 0.223]	0.163	[0.114, 0.223]	0.00	[−0.02, 0.04]	Direct only	[0.114, 0.223]
Negat. emot—>	Stress Sympt					0.195			
Regul. Teach—>	Positivity	0.220	[0.12, 0.34]	0.220	[0.12, 0.34]	0.00	[−0.04, 0.10]	Direct only	[0.12, 0.34]
Regul. Teach—>	Deep Learn							Non-effect	
Regul. Teach—>	Self–Regulation	0.107	[0.06, 0.15]	0.107	[0.06, 0.15]	0.00	[−0.04, 0.10]	Direct only	[−0.04, 0.10]
Regul. Teach—>	Procrastinat	−0.111	[−0.07, −0.14]	−0.111	[−0.07, −0.14]	0.00	[−0.07, 0.05]	Direct omly	[−0.07, 0.05]
Regul. Teach—>	Emot.coping	008	[−0.001, 0.010]	0.00	[−0.05, 0.07]	0.008	[−0.001, 0.010]	Partial mediat	[−0.001, 0.010]
Regul. Teach—>	Resilience	0.161	[0.08, 0.23]	0.00	[−0.04, 0.09]	0.161	[−0.02, 0.23]	Partial mediat	[−0.02, 0.23]
Regul. Teach—>	Negat. emot	−0.141	[−0.05, −0.25]	0.00	[−0.05, 0.08]	−0.141	[−0.05, −0.25]	Full mediation	[−0.05, −0.256]
Regul. Teach—>	Acad. confi	0.262	[0.12, 0.34]	0.144	[0.05, 0.25]	0.118	[0.06, 0.23]	Partial mediat	[0.06, 0.23]
Regul. Teach—>	Burnout	−0.229	[−0.12, −0.34]	−0.116	[−0.05,−0.25]	−0.113	[−0.09,−0.23]	Partial mediat	[−0.09,−0.23]
Regul. Teach—>	Stress Teach	−0.100	[−0.05, 0.18]	−0.100	[−0.05, 0.18]	0.00	[−0.04, 08]	Direct only	[−0.05, 0.18]
Regul. Teach—>	Stress Learn	−0.098	[−0.03, −0.21]	0.00	[−0.03, 0.09]	−0.098	[−0.03, −0.21]	Full mediat	[−0.03, −0.21]
Regul. Teach—>	Stress Sympt	−0.113	[−0.06,−0.23]	0.00	[−0.06, 0.10]	−0.113	[−0.06,−0.23]	Full mediat	[−0.06,−0.23]
Stress Teach—>	Positivity							Non-effect	
Stress Teach—>	Deep Learn							Non-effect	
Stress Teach—>	Self–Regulation							Non effect	
Stress Teach—>	Emot. coping	0.397	[0.22, 0.49]	0.338	[0.27, 41]	0.059	[0.02, 0.09]	Partial mediat	[0.02, 0.09]
Stress Teach—>	Resilience							Non-effect	
Stress Teach—>	Negat. emot	0.021	[0.010, 0.035]	0.00	[−0.03, 0.06]	0.021	[0.010, 0.035]	Full mediat	[0.010, 0.035]
Stress Teach—>	Acad. confi							Non-effect	
Stress Teach—>	Burnout	0.107	[0.05, 0.22]	0.107	[0.05, 0.22]	0.00	[−0.04, 0.09]	Direct only	[0.05, 0.22]
Stress Teach—>	Regul teach							Non-effect	
Stress Teach—>	Stress teach							Non-effect	
Stress Teach—>	Stress learn	0.535	[0.612, 0.345]	0.391	[0.421, 0.232]	0.144	[0.08, 0.21]	Part. mediat	[0.08, 0.21]
Stress Teach—>	Stress Sympt	0.261	[0.134, 0.322]	0.00	[−0.21, 0.35]	0.261	[0.134, 0.322]	Full mediat	[0.134, 0.322]
Stress Learn—>	Positivity							Non-effect	
Stress Learn—>	Deep Learn							Non-effect	
Stress Learn—>	Self–Regul							Non-effect	
Stress Learn—>	Emot copin	0.163	[0.102, 0.345]	0.163	[0.102, 0.345]	0.00	[−0.02, 0.34]	Direct only	[−0.02, 0.34]
Stress Learn—>	Resilience							Non-effect	
Stress Learn—>	Negat. emot	0.375	[0.12, 0.45]	0.375	[0.12, 0.45]	0.00	[−0.04., 07]	Direct only	[0.12, 0.45]
Stress Learn—>	Acad. confi							Non-effect	
Stress Learn—>	Engagement							Non-effect	
Stress Learn—>	Regul Teach							Non-effect	
Stress Learn—>	Stress Learn							Non-effect	
Stress Learn—>	Stress Symt	0.487	[0.523, 0.342]	0.487	[0.523, 0.342]	0.00	[−0.04, 0.21]	Direct only	[0.523, 0.342]

Bootstrapping sample size = 564. Model 4 (Teaching & Learning Factors).
Surf Learning, surface approach; Acad. confi, academic behavioral confidence; Emot. Coping or Emotion Coping, emotion-focused coping strategies; Negat. emot, negative achievement emotions; Regul. Teach, regulatory teaching; Stress Teach, stress factors of teaching process; Stress Learn, stress factors of learning process; Stress Sympt, symptoms of stress. CI, confidence interval. Bootstrapping sample size = 430.

Finally, regarding Hypothesis 4, *regulatory or effective teaching* also appeared as a negative predictor of risk factors for the SLPS competency, such as *procrastination* (Brando-Garrido et al., 2020) and *burnout* in a direct manner but also indirectly through the *stress in teaching* factor, which also predicted *negative achievement emotions* and *stress in learning*. These results are consistent with an integrated vision of teaching and learning processes in the analysis of academic phenomena at a university (Prosser and Trigwell, 1999; Rosário et al., 2013). Based on previous research and the results of the present study, the SLPS

competency includes certain *student factors*, *both presage and process*, that protect against academic stress, while other factors constitute risks for experiencing stress. Moreover, these factors coexist with *presage and process factors of teaching*, which also directly predispose and predict the experience of stress (Biggs and Tang, 2007; Kember et al., 2020; de la Fuente et al., 2021e). This evidence is highly important for university policies of prevention, assessment, and psychoeducational intervention in the emotional health and well-being of students during the COVID-19 period.

Several research *limitations* should be mentioned. On one hand, the sample was limited and may have a selection bias due to the arbitrary selection procedure. On the other hand, the sample was taken at a time prior to the health emergency. The model, then, remains to be validated *in situ*. Unfortunately, the short impact period of the COVID-19 event does not yet allow for a process evaluation. Another methodological limitation when extrapolating consequences from this research study is the fact that the data were not collected over a long period, with a longitudinal design, but were collected under a short, cross-sectional design (the real duration of the university subject). The results from paths that generated a better fit of the selected model cannot be interpreted in causal terms, given that verification, using a longer, longitudinal design, would be required. Another limitation is the molar level of analysis used in this research (de la Fuente et al., 2019b), distant from the biological processes of microanalysis. In the future, the analysis of these relationships should be contextualized within this current moment of a health emergency, and the variable of positive vs. negative *emotional reactivity* should be explored (Becerra et al., 2017), as being particularly important in this competency.

Implications for Actions During the COVID-19 Emergency

Current events are forcing us to make broad behavioral adjustments in the organization of our personal life, family life, and academic life for the weeks ahead. In order to make these adjustments smoothly, we need to keep in mind different behavioral principles and strategies. For example (de la Fuente, 2020b):

1) Presage factors:
   Students: It is important to know the characteristics of students to be able to detect which students have protective factors (and so reinforce them) and which are more likely to have personal risk factors (and so be able to intervene). The aim is to keep students from falling into a *vicious circle of risk factors* during the COVID-19 episode due to their low levels of SLPS competency.
   Teachers: Based on previous evaluations, we need to identify which teaching processes incorporate protective factors against stress (regulatory design) or, instead, involve risk factors in stress (non-regulatory or dysregulatory design). In the former case, these teaching processes should be reinforced and fine-tuned to the new situation, without big changes. In the second case, factors and adjustments that are most dysregulatory toward the learning process must be identified (e.g., drastic changes in content, methodologies, timing, and assessment). These must be avoided or corrected (de la Fuente et al., 2020e).
2) Process factors: Certain intervention strategies are suggested for maximizing the stress-buffering effect of the SLPS competency. Example:

Students: Self-Regulation and Self-Regulated Learning

1) While homebound, stay close to your usual schedule:

· Circadian rhythms and personal habits go far in helping to maintain a sequence of actions to self-regulate and to not lose motivation.

· Give yourself daily doses of positive emotions and rewarding experiences while sheltering at home. It is very important to keep a positive emotional outlook. *Distress* (diffuse negative emotionality and discouragement) can be triggered by abrupt changes in the daily rhythm of one, or by a sense of uncertainty and loss of behavioral control.

2) Self-regulate your own behavior during this period:

· Every day, *plan* objectives, schedules, and actions, being flexible but also systematic.

· Exercise *control* over your own behavior. Force yourself to continue working and also to stop and take leisure time (a substitute for outside activities). Tell yourself that you are doing the right thing. Use different relaxation techniques to decrease any anxiety.

· It is not a good time to take on serious, complex issues in your life situation, because this may cause even greater stress and loss of situational control. If it is truly necessary, make small, gradual adjustments.

·Take advantage to catch up on pending matters, whether personal, family-related or academic tasks. This is a gift of time.

· *Evaluate* your behavior at the end of the day and redefine your objectives (family related, personal, and academic) for the next few days.

Teachers: Self-Regulation and External Regulation of Students

1) In the subjects you teach, maintain a regulatory approach that gives your students a perception of control and continuity:

• Keep your usual hours of contact with the students, using appropriate technology. Direct online classes allow you to continue with the subject and lessen anxiety about the students.

· Make every adjustment you can so that all participants perceive normality and a sense of control. It is best to keep up the regular pace of the subject while making adjustments that the situation requires. It is not a good time to make big, unexpected changes.

· If needed, adjust your assessment activities and system during this period. Make students aware that the new situation means new behavioral challenges, including the chance for them to practice online teamwork from home.

2) Apply external regulation to help students in their learning process:

• If you have not already done so, this is a good time to convert all learning resources to online formats and encourage students to learn autonomously from home.
· *Plan* regular, general messages and aids for your students so they feel that the teaching-learning process continues with some normality.
· *Offer* personalized online tutoring for students who need it. It is especially important to keep direct contact with the student representative in each class in order to be informed of any possible problems or help that the students are needing.
· Regularly *reevaluate* whether students need adjustments to the material, assignments, etc.
· Pay attention to the emotional state and expectations of your students. Convey calm and assurance with your own behavior. Your students see themselves reflected in you and your demeanor when interacting with them. Become a *mentor* that supports the process, also on an emotional level.
3) Product factors: For students with risk factors or vulnerability to stress, in addition to the steps mentioned above, specific emotional regulation techniques like mindfulness (de la Fuente et al., 2018) or emotional refocusing (Quoidbach et al., 2010) should be worked on, given their effectiveness in the short and long term.

CONCLUSION

Empirical models of university academic stress can be useful for: (1) detecting university students who may be at risk during health emergencies like COVID-19; (2) designing psychoeducational learning support systems for students who are experiencing stress in this situation; (3) promoting teaching strategies that protect against academic stress in this context. If we have preventive models of this academic phenomenon, it will be easier to prepare ourselves sooner for emergencies like the one we are currently experiencing. It is very important that certain behavioral repertories be implemented, and so act as psychological vaccines for coping with stress and improving well-being at a university. This is done through psychoeducational programs that improve the competence of students and teachers before the symptoms of academic stress set in (especially in large-scale events like COVID-19) (Coulson, 2019; Young et al., 2020). The services of our University Guidance and Psychology Departments should be an essential, irreplaceable tool for accomplishing this task. The analysis heuristic presented here could be used by Applied Psychology Units at universities for evaluating and intervening in processes of academic stress.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Ethics Committee of the University of Navarra (ref. 2018.170). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JdF: conceptual design, data analysis, writing the article, and R&D Project management.

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Well-Being of Adolescents in De-Escalation Situation: Physical, Emotional, Social, and Academic Impact

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The Covid-19 pandemic has changed the world we knew in recent months. In the interest of maintaining social distance, lockdown periods have been established and schools in many countries have closed their doors. In this context, the objective of this research was to analyze the well-being of adolescents in Spain after lock-down and during the de-escalation process in a holistic way; taking into account their indicators on physical, emotional, social, and academic levels. The "Well-being of Children in Lockdown" (WCL) scale was used to measure the well-being of adolescents using these same parameters. The results point out that the general well-being of adolescents in the pandemic situation was situated at an intermediate level. Taking into account the different aspects measured within the general well-being, the domains that obtained the lowest scores were the domains of addictions and playful and creative activities. Intermediate scores were also obtained in the physical activity, emotional and academic domains, with the routine and academic domains having the highest scores. Boys and younger adolescents are those who show higher scores in the general well-being. Moreover, correlations appear between academic task stress and emotions, playful and creative activities, addictions, physical activity, routine, academic and overall well-being.

Keywords: well-being, school task, emotion, adolescence, COVID-19 pandemic

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INTRODUCTION

The COVID-19 pandemic has changed the world as we knew it in few months. Although the first cases of an unknown pneumonia appeared at the end of 2019 in the city of Wuhan (China), its expansion was exponential, affecting China first and then spreading to the rest of the world (Chen Q. et al., 2020; Torales et al., 2020). In fact, since the beginning of March, COVID-19 has been considered a pandemic and countries world-wide have created contingency plans to face it (WHO, 2020).

In the interest of reducing COVID-19 infections, social distancing has been a crucial tool. In consequence, schools in many countries closed their doors and adolescents were confined to their homes all over the world (United Nations Educational, Scientific and Cultural Organization, 2020).

However, the management of such lockdowns or their restrictions varied in each country. Spain was one of the countries with the hardest restrictions for children and adolescents, as for 6 weeks (from March 14 to April 26) they were completely locked down and forbidden to leave their homes (Garcia, 2020). From April 26 onward, the Spanish government allowed children under 14 to go out, but only for 1 h every day and always near their homes (Lucas, 2020). As of May 4, people over 14 were also allowed to go out, but only to practice sports and this also with time restrictions. When this research was carried out, children under 14 could go out of their houses only 1 h a day, while those over 14 years of age were able to go out for more time slots (Sanchez, 2020).

It is crucial to analyze the disruptive effects of COVID-19 on adolescents as this could have multiple consequences in their lives; they are a vulnerable group who are experiencing a difficult time of transition (Larsen and Luna, 2018). The consequences may include chronic and acute stress, concern for their families, unexpected life losses, or increased access to the Internet and social networks due to the abrupt interruption of classes and lockdown (Guessoum et al., 2020). In fact, the consequences that this period of lockdown may have on children and adolescents have aroused the concern of pediatricians, psychologists, and educators (Grechyna, 2020; Jiloha, 2020). These professionals point out that the well-being and the health of adolescents could be affected at different levels and that it is essential to investigate this in order to help them to better cope with this crisis (Dalton et al., 2020; Wang et al., 2020).

Therefore, as far as age is concerned, it is well known that adolescence represents a critical period of rapid physical, social, cognitive, and emotional changes, with important implications for health and well-being in later life (Pigaiani et al., 2020). Different studies around the world have shown that younger age has been where people have shown less well-being during the pandemic (Pieh et al., 2020). However, few studies have been conducted to indicate at what point in adolescence may have had the greatest influence on people's well-being.

But in the few studies that have been conducted, it has been shown that among adolescents, being in the higher grades is a risk factor for adolescents (Chen S. et al., 2020; Zhou et al., 2020). This is because the higher the academic course the greater the pressure on students (Zhang et al., 2005; Yuan et al., 2018) and because their independence is more compromised. In addition, the older is the adolescent, the greater is the importance of social relationship. Adolescents have amplified energy, novelty, motivation, curiosity, and enthusiasm that make it difficult to isolate them at home. The hormonal changes that accompany puberty combine with the social dynamics of adolescents to make them very sensitive to social status, peer group, and relationships. Adolescents may feel frustrated, nervous, disconnected, homesick, and bored due to social distancing during this pandemic (Imran et al., 2020).

In terms of gender, both studies conducted worldwide with adults (Moghanibashi-Mansourieh, 2020; Pieh et al., 2020; Rossi et al., 2020) and adolescents (Chen S. et al., 2020; Engel de Abreu et al., 2021), point to females having worse well-being during the COVID-19 pandemic. This is because there is still much to be done for gender equality, which is what increases women's well-being (Diener et al., 2018).

Although the concept of well-being is highly variable and has been studied across a wide range of disciplines, age groups, cultures, communities, and countries, resulting in an assortment of definitions (Pollard and Lee, 2003), from a holistic point of view, well-being has been defined as "a multidimensional construct incorporating mental/psychological, physical and social dimensions" (Columbo, 1986, p. 288). In the same vein, it should be borne in mind that, according to the World Health Organization (WHO, 1946), "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (p. 100).

In the case of adolescents, school closures and social distancing could be even more harmful to their well-being since during adolescence young people grow in independence and give priority to their peers over their parents. The disruption of these peer-to-peer direct contacts may therefore pose significant challenges to young people's well-being (The Lancet Child Adolescent Health, 2020).

On the physical level, it has been already demonstrated that lockdown has brought about a decrease in physical activity accompanied by an increase in sedentary behavior (Ammar et al., 2020). A study conducted in Latin America and Europe found a high prevalence of physical inactivity among adolescents during lockdown, regardless of their country. Consumption of ultra-processed foods was also high during this period in both regions (Ruíz-Roso et al., 2020). The lack of activity and poor nutrition that can occur in a COVID-19 lockdown may have the effect of causing or worsening obesity among adolescents. This is an issue to be aware of, since obesity can worsen the prognosis of adolescents who become infected with COVID-19 (Nogueira-de-Almeida et al., 2020).

On the emotional level, the rapid increase in the number of cases of infection and deaths, disruption of daily routines, lockdown, fear of infection, social distancing from peers and friends, and lack of access to educational resources may create feelings of uncertainty and anxiety among adolescents (Imran et al., 2020). Adolescents may also experience anxiety as they try to understand the pandemic and the threat it poses to them, their families and friends (The Lancet Child Adolescent Health, 2020). A study carried out during the lockdown in the Netherlands collected the subjective experience of the COVID-19 pandemic among adolescents (Janssen et al., 2020). Results highlighted the fact that they were disturbed by the lack of social contact with friends, irritated with their family members and concerned about the health of others.

On the social level, social distancing and school closures are likely to result in greater feelings of loneliness for adolescents (Loades et al., 2020). Many young people have been concerned about losing connection with friends, non-immediate family, and other trusted adults. This may be especially dramatic among those vulnerable adolescents who did not feel safe to talk with others from their homes or who have limited access to technology. In addition, some young people have already pointed out that they felt that talking online is not as satisfying as being

in direct contact with their friends (Young Minds, 2020). In fact, from the beginning of the lockdown, more than one third of the adolescents reported high levels of loneliness (Oxford ARC Study, 2020; Young Minds, 2020). This feeling of loneliness may be due to the importance of peers in the evolutionary stage of adolescence (Meeus and Dekoviíc, 1995).

On the academic level, school and university closures had affected over 91% of the world's student population (Lee, 2020). This may have important consequences as schools create structures in the routines of the adolescents that help their emotional stability (Young Minds, 2020). Moreover, the closure of schools has created great uncertainty among adolescents about their future, causing anxiety because of the cancellation of exams, exchange programs, and academic events (Lee, 2020). For teens in vulnerable or at-risk situations, school closures can also represent the loss of a stable and safe environment.

In sum, the COVID-19 pandemic is creating multiple threats to adolescents' health and well-being. For this reason, it is necessary to conduct studies that determine how they are coping both with lockdown and the de-escalation processes or periods of restrictions. Moreover, adolescents' well-being should not be researched from a single perspective, level or indicator, as their lives are lived in multiple domains and each domain influences their well-being (Ben-Arieh et al., 2001; Bradshaw and Mayhew, 2005; Hanafin et al., 2007; Land et al., 2007).

In this context, the objective of this research is to analyze the well-being of adolescents in the pandemic situation. In fact, the contextualization of this study goes beyond the period of lockdown and aims equally to study the welfare of adolescents in periods of restrictions due to COVID-19 in the north of Spain. Moreover, their well-being is researched in a holistic way, that is, taking into account their indicators at physical, emotional, social, and academic levels or domains. Moreover, whether well-being is affected by the age or gender and by stress related to academic tasks is also analyzed.

METHODOLOGY

Sample

The sample was comprised of 500 adolescents from the Basque Autonomous Country (North of Spain). Of the sample, 64.6% were girls (n = 323), 34.8% were boys (n = 174) and.6% non-binary (n = 3). With regard to age, 41.7% were aged between 12 and 14 years (n = 207), 35.5% between 15 and 16 years (n = 176) and 22.8% between 17 and 18 years (n = 113). Of those%15.2 were attending to the first course of secondary education (n = 76), 14.6% second course of secondary education (n = 73), 24% third grade of secondary education (n = 120), 17.2% fourth grade of secondary education (n = 86), 10% first grade of bachelor studies (n = 50), 14% second grade of bachelor studies (n = 70), 2.2% first grade of professional training (n = 11) and 0.6% second grade of professional training (n = 3). According to their family socio-economic status the majority 42.3% has a bachelor studies (n = 211.5) or 28.7% university studies (n = 143.5), 15.1% has secondary studies (n = 75.5) and 12.1% primary studies (n = 60.5) and 1.9% do not have studies (n = 9.5). Regarding to their parents occupation the majority 37.5 was specialized worker (such as plumber, waiter, etc.), 29.7% were has high degree (such as layer, teacher, doctor, etc.) (n = 148.5), 8% were manufacture worker or laborer (n = 49), 7.2% is the owner of a big company (with more than 25 employees) (n = 36), 3.4% was retired (n = 17), 2.3% were unemployed (n = 11.5%) and 1.9% was domestic worker.

Instrument

The "Well-Being of Children in Lockdown (WCL)" scale (Berasategi et al., 2020) was employed to measure the well-being of adolescents at physical, emotional, social, and academic levels. This scale had been previously validated for the Spanish child population (Berasategi et al., 2020). It consists of 22 items and the overall alpha value of the scale was 0.804. The instrument comprises six sub-scales: emotions (five items), playful and creative activities (four items), academic (three items), addictions (four items), routine (four items), and physical activity (two items). The items included in the first domain are related to emotions (such as crying more than usual, feeling more nervous than usual, getting angry more than usual); those in the second are related to playful or creative activities (such as taking part in creative activities; e.g., theater, music, and art, playing different games throughout the day, doing leisure activities with family throughout the day); the third domain consists of items related to academic issues (such as having been sent materials, assignments, and homework by your school, spending enough time on your schoolwork during the day, working on school projects with your family throughout the day); the items of the fourth are related to addictive habits regarding technology or eating [such as eating more treats (e.g., cookies, chocolate, and chips) during lockdown, over-using new technology]; the fifth domain is concerned with daily routines including the maintenance of a daily schedule of eating and sleeping habits (such as having an agreed routine and trying to stick to it, eating a well-balanced diet, having healthy sleeping habits); and finally, the sixth domain contains items related to physical activity (such as getting enough physical exercise during the day, moving their body around sufficiently). The participants were required to respond on a 4-point Likert-type scale ranging from strongly agree (4) to strongly disagree (1). The data from the negative statements were recoded positively. Therefore, in the domain of emotions, you will measure how many positive emotions are felt and the domain of addictions will be higher the fewer addictions they have.

The estimated reliability coefficients were for the original scale 0.872 for the first factor, 0.783 for the second, 0.696 for the third, 0.627 for the fourth, 0.646 for the fifth, and 0.847 for the sixth factor. The reliability of the entire scale was 0.804. The various domains and the overall scale have shown adequate values of internal consistency ($>$0.60). In this case scale was administrated to a population between 15 and 18 years and also the reliabity coeficients shown adecuate internal consistency, for the first factor 0.813, for the second 0.806, 0.676 for the third, 0.645 for the fourth, 0.707 for the fifth, and 0.605 for the sixth factor. The reliability of the entire scale was 0.787. The various domains and the overall scale have shown adequate values of internal consistency ($>$0.60).

In addition, four *ad hoc* questions were asked specifically for this research and related to the stress of academic work during confinement. The responses for these three items were Likert-type from 1 to 4 points, from strongly agree (4) to strongly disagree (1). The items were "I am happy to be at home and do homework from home," "Homework is a source of conflict at home," "I feel that I am stressed by the large amount of homework," "I spend too much time doing homework from home." The reliability of the items as a whole was 0.85. Sociodemographic data were also collected, namely the sex and age of the adolescents.

Procedure

In order to recruit the participants, all the centers registered in the database of the Department of Education of the Basque Government were contacted by email and were asked to disseminate an online questionnaire to their students. Both the data of the sample and the parents' consent for participating in the study were collected with the help of Google online forms. Family members were informed of the research study by e-mail. In the same questionnaire, it was explained that participation in the study was voluntary and anonymous. Moreover, the parents or legal guardians of the children gave written consent for two phases of this research. First, consent was given to analyze the data and second, to make the data public in scientific articles while respecting anonymity. A total of 30 questionnaires were excluded for not giving consent for this second phase. The data were collected during the first phase of the de-escalation, May 11–25, 2020. This research has obtained the approval of the Ethics Committee of the UPV/EHU [M10/2020/055].

Data Analysis

Data were analyzed using IBM SPSS Statistics for Windows, Version 26.0, Armonk, NY, United States. The ANOVAs were used to analyze the difference between gender and age. To analyze differences between categoric variables, the Tuckey statistic was used. In turn, the effect size associated with each comparison of means was calculated by using the square eta. The Pearson *r* statistic was used to made correlations between the different variables analyzed.

RESULTS

The Well-Being of Adolescents From a Holistic Perspective

The overall levels of well-being of adolescents are in an intermediate level under 3 (M = 2.68) (see **Table 1**). Likewise, the media of the different domains measured by the scale are also between 2 and 3. The lowest scores are obtained in the practice of playful and creative activities (M = 2.18), addictions (M = 2.34), and physical activity (M = 2.59) domains. The highest scores are obtained in routine (M = 3.03), with this being the only domain that is higher than three points, and in the academic domain (M = 2.97).

Taking into account the responses (see **Table 2**) in the academic domain, 68% (n = 340) of the adolescents think that they have received too many academic tasks and 40.8% (n = 204) think that they have spent too much time on these. However, only 5.2% (n = 26) said that they spent a lot of time doing school projects with their parents.

TABLE 1 | Descriptive analysis of the different dimensions of well-being.

Dimensions	*n*	Min	Max.	*M*	SD
Emotions	500	1.67	4.00	2.79	0.71
Playful and creative activities	500	1.00	4.00	2.18	0.39
Academic	500	1.00	4.00	2.97	0.46
Addictions	500	1.00	4.00	2.34	0.56
Routine	500	1.00	4.00	3.03	0.57
Physical activity	500	1.00	4.00	2.59	0.73
Well-being Total	500	1.52	3.81	2.68	0.36

With regard to the routine domain, the option of having experienced a much-agreed routine has been indicated by 33.6% (n = 168) of the adolescents, whereas 49% (n = 245) said that they have some routine. Likewise, 27% (n = 185) say that they eat breakfast, lunch, and dinner at the same time each day and 44.2% say that they do this sometimes (n = 221). Moreover, adolescents say that they have many habits (24.8%, n = 124) or some habits (44%, n = 220) of healthy sleeping and much (24%, n = 122) or some (56%, n = 280) balanced diet.

As regards the physical activity domain, 11.8% (n = 59) of the adolescents say that they do much exercise and 36.3% (n = 183) say they do some. In the same way, 14% (n = 70) say they move their body around much and 42.2% (n = 211) some.

With regard to the emotional domain, the majority of the adolescents think that they cry more than usual [49.8% said much (n = 249) and 26.8% said some (n = 134)]. 28.2% (n = 141) indicate that they are much more nervous and 25.8% (n = 129) indicate the option somewhat more nervous. 16.2% (n = 81) said that they get much more angry than usual and 30.8% (n = 154) indicate the option somewhat angrier. Likewise, adolescents feel much sadder 32.6% (n = 163) or somewhat sadder 33.6% (n = 168). However, some of them also say that they feel much happier 12.2% (n = 61) or somewhat happier 58.0% (n = 290).

With respect to the addictions domain, 19.8% (n = 99) think that they are eating much more than usual and 39% (n = 195) that they are eating some more. Moreover, adolescents are eating many more (23.2%; n = 116) or some more (44.4%; n = 222) treats and sweets. However, only 2.0% (n = 10) think that they are over-using the new technologies much and 10.4% (n = 52) that they are over using somewhat. In the same vein, only 9.2% (n = 46) think that they are watching too much TV and 26.8% (n = 134) that they are watching somewhat too many TV programs.

Finally, with regard to the playful and creative activities domain, the adolescents think that they are taking part in creative activities much (9.4%; n = 47) or some (25.8%; n = 129). Likewise, they think that they play different games throughout the day much (11.8%; n = 59) or some (41.0%; n = 205). However, only 5.2% of adolescents think that they play with their family much throughout the day 5.2% (n = 26) and 23.6% think that they play some (n = 118).

TABLE 2 | Percentages of well-being of their children in confinement situation: academic aspect, routine, physical activity, emotions, additions, playful, and creative activities.

	Nothing		Few		Some		Much	
	n	%	*n*	%	*n*	%	*n*	%
Academic aspects								
Item 1. You have been sent materials, assignments, and homework by your School	6	1.2	8	1.6	146	29.2	340	68
Item 2. You spend enough time on your schoolwork during the day	4	0.8	43	8.6	249	19.8	204	40.8
Item 20. You work on school projects with your family throughout the day	184	36.8	172	34.4	118	23.6	26	5.2
Routine								
Item 3. You have an agreed routine and you try to stick to it	21	4.2	66	13.2	245	49	168	33.6
Item 4. You usually have breakfast, lunch, and dinner at the same time each day	26	5.2	68	13.6	221	44.2	185	27
Item 7. You have healthy sleeping habits	33	6.6	123	24.6	220	44	124	24.8
Item 13. You are eating a well-balanced diet	24	4.8	74	14.8	280	56	122	24
Physical activity								
Item 5.You get enough physical exercise during the day	45	9.0	213	42.6	183	36.6	59	11.8
Item 6.You move body (around) enough	17	3.4	202	40.4	211	42.2	70	14.0
Emotions								
Item 8. You cry more than usual	43	8.6	74	14.8	134	26.8	249	49.8
Item 9. You feel more nervous than usual	75	15.0	155	31.0	129	25.8	141	28.2
Item 10. You get angry more than usual	94	18.8	171	34.2	154	30.8	81	16.2
Item 11. You feel sadder than usual	55	11.0	114	22.8	168	33.6	163	32.6
Item 12. You are happy	18	3.6	131	26.2	290	58.0	61	12.2
Addictions								
Item 14. You are eating more than usual during lockdown	49	9.8	157	31.4	195	39.0	99	19.8
Item 15. You are eating more treats (e.g., cookies, chocolate, and chips) during lockdown	46	9.2	116	23.2	222	44.4	116	23.2
Item 16. You are over-using new technology	240	48.0	198	39.6	52	10.4	10	2.0
Item 17. You are watching too many TV programs, cartoons, or movies	111	22.2	209	41.8	134	26.8	46	9.2
Playful and creative activities								
Item 18 You are taking part in creative activities (e.g., theater, music, and art)	159	31.8	165	33.0	129	25.8	47	9.4
Item 19. You play different games throughout the day	36	7.2	200	40.0	205	41.0	59	11.8
Item 22. You play with your family throughout the day	184	36.8	172	34.4	118	23.6	26	5.2

The Well-Being of Adolescents in De-Escalation by Gender and Age

The results in **Table 3** show that there are significant differences in the overall well-being, with boys obtaining higher scores $V = 0.079[F\ (7,489) = 5.99,\ p = 0.001],\ \eta^2 = 0.08]$. In the same way, significant differences arise in relation with emotions, with boys having higher levels in the emotional domain (more positive emotions) $[F\ (1,495) = 38.23,\ p = 0.001,\ \eta^2 = 0.07]$ and addictions domain (fewer addictions) $[F\ (1,495) = 5.61, p = 0.018,\ \eta^2 = 0.011]$.

On the other hand, taking into account the Multivariate Contrasts of Pillai's Trace in relation to age, $V = 0.081$, $[F\ (2,488), = 5.12,\ p = 0.001,\ \eta^2 = 0.07]$, significant differences arise in the general well-being $[F\ (2,493) = 7.72,\ p = 0.001,\ \eta^2 = 0.03]$ with the younger adolescents (12–14 years) having higher scores. Similarly, differences arise in routine $[F\ (2,493) = 4.22,\ p = 0.015,\ \eta^2 = 0.02]$, emotion $[F\ (2,493) = 4.83,\ p = 0.008,\ \eta^2 = 0.02]$, and playful and creative activities $[F\ (2,493) = 10.52,\ p = 0.001,\ \eta^2 = 0.04]$, again with the younger ones having higher scores in all of these domains.

Academic Task Stress and the Well-Being of the Adolescent

Table 4 shows the six well-being domains and the overall well-being of the participants and their correlation with the academic task stress. In fact, correlation exists between stress and all of the well-being domains in the total sample: emotions ($r = 0.440$), playful and creative activities ($r = 0.214$), addictions ($r = 0.279$), routine ($r = 0.206$), and physical activity ($r = 0.238$). In the same way, correlations exist between academic task stress and overall well-being ($r = 0.334$). In this sense, it could be said that the less stress the academic tasks caused to the participants, they feel more positive emotions, carry out more playful and creative activities, have less addictive behaviors, have more established routines and practice more physical activity. This table also shows the correlations of well-being controlling for sex and age of the sample.

DISCUSSION

In this research, the well-being of adolescents in the pandemic situation was analyzed from a holistic perspective, taking into account different aspects such as physical, emotional, social and academic domains. Firstly, the results of the study point out that the general well-being of adolescents in a lockdown situation is situated at an intermediate level. Taking into account the different aspects measured within the general well-being, the domains that obtained the lowest scores were the addictions and playful and creative activities that they carry out; that is to say, teenagers tended to engage in addictive activities, and were less likely to

TABLE 3 | Descriptive analysis and multivariate and univariate analysis of the different dimensions of well-being by sex and age.

Dimensions					
Sex		***n***	***M***	**SD**	
Emotions	Boy	174	3.05	0.62	
	Girl	323	2.66	0.72	
Playful and creative activities	Boy	174	2.20	0.54	
	Girl	323	2.17	0.65	
Academic	Boy	174	2.94	0.49	
	Girl	323	2.98	0.44	
Addictions	Boy	174	2.43	0.57	
	Girl	323	2.30	0.56	
Routine	Boy	174	3.09	0.54	
	Girl	323	2.99	0.54	
Physical activity	Boy	174	2.60	0.76	
	Girl	323	2.57	0.71	
Well-being Total	Boy	174	2.77	0.33	
	Girl	323	2.63	0.37	
Age		***n***	***M***	***SD***	
Emotions	12–14	110	2.93	0.65	
	15–16	200	2.84	0.73	
	17–18	186	2.64	0.70	
Playful and creative activities	12–14	100	2.41	0.62	
	15–16	200	2.20	0.59	
	17–18	186	2.03	0.53	
Academic	12–14	110	3.05	0.47	
	15–16	200	2.99	0.45	
	17–18	186	2.91	0.47	
Addictions	12–14	110	2.39	0.61	
	15–16	200	2.32	0.56	
	17–18	186	2.35	0.56	
Routine	12–14	110	3.17	0.53	
	15–16	200	3.01	0.60	
	17–18	186	2.95	0.57	
Physical activity	12–14	100	2.61	0.71	
	15–16	200	2.58	0.74	
	17–18	186	2.56	0.74	
Well-being Total	12–14	207	2.75	0.37	
	15–16	276	2.66	0.35	
	17–18	2.58	2.58	0.37	
Sex	***F***	***gl***	***p***	η^2	
Emotions	38.24	1	0.001***	0.07	
Playful and creative activities	0.364	1	0.547	0.001	
Addictions	5.61	1	0.018*	0.01	
Academic	1.25	1	2.64	0.003	
Routine	2.94	1	0.087	0.006	
Physical activity	0.212	1	0.646	0.001	
Well-being Total	15.95	1	0.001***	0.03	
Age	***F***	***gl***	***p***	η^2	***Post hoc***
Emotions	4.834	2	0.008**	0.02	1>3 3>1
Playful and creative activities	10.52	2	0.000***	0.04	1>3 2>3 3>1
Addictions	0.708	2	0.493	0.003	
Academic	1.686	2	0.187	0.007	
Routine	4.22	2	0.015**	0.02	
Physical activity	0.778	2	0.460	0.003	1>3;3>1
Well-being Total	7.72	2	0.001**	0.03	1>3;3>1

****p < 0.001.*
***p < 0.01.*
**p < 0.05.*

engage in any playful or creative activities. Intermediate scores were also obtained in the emotional domain and the physical activity that young people practice, with the routine aspects and academic aspects (the perception that they have that they received sufficient school tasks and that they spend enough time doing these) having the highest scores.

As for the academic domain, one of the biggest concerns of the adolescents during the lockdown has been their schoolwork and the uncertainty about their academic future (Lee, 2020). In the present study, most adolescents have reported spending a lot of time doing academic work, though many have not received help from their parents. Although having done a lot of academic work may be favorable to their academic development, we must contemplate that adolescents have had to face this challenge alone. There are few parents who have helped or have been able to help their sons and daughters, either because they were working too (Roig and Nebot, 2020) or because they did not have the necessary academic level (Vivanco-Saraguro, 2020). Indeed, another fact to take into account is that schoolwork has been one of the causes of conflict in families during lockdown (Burgess and Sievertsen, 2020; Cluver et al., 2020; Idoiaga et al., 2020). In fact, the involvement of parents in helping their children academically and taking care of relationships could help not only in their performance, but also in the development of the adolescents' self-concept, an important aspect to foster during adolescence (Álvarez et al., 2015). Therefore, the state of lockdown has not been the most favorable for the education of adolescents and has had negative effects on educational aspects (Abad, 2020).

Regarding the routine domain, not having face-to-face classes could alter adolescents' routines, as indicated by some authors (Young Minds, 2020). However, in the present study, the adolescents reported having good routines and having maintained the appropriate breakfast/lunch/dinner routines. They have also had a good quality of sleep, which is essential for taking care of their physical, psychological, and cognitive health. Sleep has a repairing effect and helps to reinforce the memory, which is essential for their academic performance (Rasch and Born, 2013; Troynikov et al., 2018. Therefore, despite the fact that the adolescents have been in the harsh conditions of lockdown, they have been able to maintain routines and this has been a favorable outcome for their well-being.

In contrast to other studies that reported that confinement brought decreased physical activity and sedentary behavior among adolescents (Ammar et al., 2020; Ruíz-Roso et al., 2020), many adolescents in the sample reported getting plenty of exercise. This is an aspect that plays in the adolescents' favor, since 150–300 min of exercise per week has been recommended during the pandemic (Piercy et al., 2018) as some data indicate that exercise may reduce the risk of acute respiratory distress syndrome, per COVID-19 (University of Virginia Health System, 2020). Sport has been able to help adolescents not only to stay physically healthy, but also to manage the stress of the pandemic and avoid other bad habits, such as alleviating stress with food or other substances (Nyenhuis et al., 2020). In addition, it has been proven that sports have a favorable influence on academic performance (Bradley et al., 2013).

TABLE 4 | The correlations between academic task stress, well-being domains and the overall well-being, controlling for gender and age.

	Academic task stress-total sample	Boy	Girl	12–14	15–16	17–18
Emotions	0.440**	0.388**	0.457**	0.452**	0.446**	0.474**
Playful and creative activities	0.214**	0.043	0.190**	0.094	0.140	0.147
Addictions	0.279**	0.261**	0.292**	0.245**	0.344**	0.311**
Routine	0.206**	0.042	0.186**	0.151**	0.261**	0.003
Physical	0.238**	0.004	0.092	0.056	0.011	0.141
Academic	0.232**	0.315**	0.249**	0.311**	0.225**	0.272**
Overall well-being	0.334**	0.199**	0.369**	0.291**	0.400**	0.337**

$^{**}p < 0.01$.

However, most adolescents have admitted to eating more during lockdown, and mostly to eating more unhealthy food. Beyond the risks that the increase in the rate of obesity may pose in the long term, it should also be taken into account that an optimal nutritional status is essential during a pandemic to strengthen the immune system (Iddir et al., 2020). Poor eating habits acquired during the lockdown may also have influenced their education because poor diet has been shown to lower academic performance (Florence et al., 2008).

One of the most surprising results of this research is the low number of adolescents who admit to having abused new technologies or screens. In itself, this seems a positive aspect, but it is very striking because all indications and research worldwide point to the fact that new technologies and screens have been abused during lockdown (Montag and Elhai, 2020). We should therefore ask ourselves and analyze whether in fact adolescents are aware of this abuse or have framed it as something normal since they are already prone to spending more time than adults using ICTs (Salaway et al., 2008). In fact, if young people do not have the capacity to see or admit to a problem concerning the overuse of technologies, the problem of this addiction would be aggravated and urgent strategic plans for training and awareness would be necessary.

In addition, the abuse of technology may also arise from the difficulty of managing stress created by the pandemic. The emotional and academic difficulties of adolescents are more likely to be a cause of the abusive use of technology (de la Villa Moral and Suárez, 2016; Hawi and Samaha, 2016; Sert et al., 2019) and it is therefore important to pay attention to the emotional care of adolescents during lockdown and restrictive periods.

In the emotional domain, from the beginning of the pandemic, adolescents have been cataloged as an at-risk population (The Lancet Child Adolescent Health, 2020). In the present study, they have admitted to being more nervous and sadder than usual, maybe because of being away from their peers, which is very important for their age-group (Meeus and Dekoviíc, 1995). In fact, adolescence is a time of transition when young people may already be experiencing difficult emotional moments (Imran et al., 2020). It is therefore important to promote their well-being by encouraging them to remain calm and take measures to reduce stress (Guessoum et al., 2020). Indeed, the World Health Organization published recommendations addressed to adolescents from the beginning of the pandemic to help them cope with stress (WHO, 2020).

Regarding the playful and creative activities, teenagers are not feeling very creative or playing much with the family. This may be due to the fact that, in adolescence, play is not like in the childhood stage and adolescents start to interact more with their peers (Meeus and Dekoviíc, 1995) and not feel so comfortable with parents. Adolescents attach more importance to their peers than to the family at this stage, which is why they may be feeling high levels of loneliness and boredom (Oxford ARC Study, 2020; Young Minds, 2020).

As far as gender differences in adolescents are concerned, the results show that boys have expressed more emotions than girls in the present study. In fact, it has been observed that boys have a greater positive emotional expression. These results contradict studies that say that girls tend to be more likely to express positive emotions (Brody, 1999; Chaplin and Aldao, 2013). This may be due to the fact that women have shown less well-being than men in this study and therefore express less positive emotions. In fact, there is often a tendency for girls to internalize feelings of distress, which may increase their propensity for depression (Zahn-Waxler et al., 2008).

With respect to age differences, it is the younger adolescents who show the greatest well-being compared to the older ones. This may be due, among other things, to the fact that they do not yet have the same pressure from academic staff as the older ones who are finishing their studies of secondary education. In fact, the schooling of adolescents and having to study at a distance has also been one of the greatest challenges of this pandemic and one of the main stressors for families (Burgess and Sievertsen, 2020; Cluver et al., 2020). In addition, the fact that older adolescents do more academic work, due to the demands that the last stage of secondary education brings, could lead them to have less healthy habits and take less care of their eating and sleeping routines. That is, older students may be experiencing anxiety about university entrance exams (Sari et al., 2018), and therefore have less healthy habits and not take care of routines. It may moreover be because they have less free time that older adolescents also practice creative activities to a lesser degree.

Finally, with regard to the academic task stress, results have indicated that this correlates with the overall well-being of the adolescents, and also with some of the different analyzed domains (routine, physical exercise, additions, academic aspects, and creative and playful activities). The emotional domain is the one that show the highest negative correlation with academic stress, that is to say, the more stressed the teenagers were, the less emotional well-being they had. Likewise, from these results, we can also conclude that having a greater well-being and taking care of the physical, emotional, playful and routine domains may be also important for preventing the stress of academic tasks. In addition, it is known that

stress has a negative influence on academic performance (Arsenio and Loria, 2014), so it is important to take care of this aspect during lockdown or emergency e-learning periods to improve the education of adolescents.

Therefore, from a holistic perspective of adolescent well-being, the results of this research have shown that the overall well-being of adolescents in lockdown is at an intermediate level. This may be due to a balance between different dimensions. That is, the low levels of well-being related to addictions (mostly for screen use and eating behaviors) and playful activities, the intermediate levels created by ambibalent emotions and physical activity, and the high levels of routine and academic aspects make for an intermediate level of total well-being. These results are not critical but should be viewed with caution and followed up as the pandemic period does not end with lockdown and restrictions for children and adolescents are still in place in many countries.Therefore, it would be important to carry out similar cross-sectional studies.

Regarding the limitations of the study, the main limitations are related to the measurement instruments used. The questionnaire used to assess well-being is validated in a population between 2 and 14 years of age; however, the study sample is between 12 and 18 years of age, and the questionnaire has been supplied in this population with good internal consistency and reliability. Likewise, the instrument used to assess the stress of the academic task during confinement is *ad hoc* perhaps for further analysis will be interesting to add other validated scales to measure this. Therefore, the analyses performed with these questions should be interpreted with caution.

Moreover, the generalizability of the results is limited, since it is a non-probabilistic sample in which there may be a certain selection bias. That is, participation was voluntary, and the respondents may well have been adolescents who were especially emotionally impacted by the pandemic. Future studies should expand the sample and extend it to more countries.

CONCLUSION

In conclusion, the results show that the pandemic situation and the different measures that the government is taking to protect the health of the population (such as the lockdown or restrictive periods) are generating a direct effect on adolescents. For this reason, it is important to take care of this vulnerable collective by attending to their well-being and promoting quality socio-educational policies based on the needs that have been identified in this study. To accompany adolescents in their educational processes, to offer them spaces to carry out physical activities, to promote habits that safeguard their routines, to encourage them to participate in creative and playful activities, to guarantee that they continue to maintain relationships with their peers, to give them tools to be able to face this new situation emotionally and to control the excessive consumption of food and use of screens are therefore some of the key factors that we must address in the near future.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of the Basque Country. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

NB and MD-S were involved in the and analysis of the data. NI and N-OE were involved in the interpretation of the data. All authors were involved in the conceptualization of the project, acquisition of the data, drafting and revising of the work for intellectual content, provided approval for submission of the contents for publication, and agreed to be accountable for the accuracy and integrity of the project.

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Depression and Anxiety in Times of COVID-19: How Coping Strategies and Loneliness Relate to Mental Health Outcomes and Academic Performance

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The link between depression, anxiety, and loneliness has been well established in the literature. Yet, the performance consequences of these negative mental health outcomes and the role of coping behaviors, as well as behavioral consequences such as procrastination as mediators have received far less research attention. Due to the COVID-19 social isolation restrictions, people are at risk of falling into a negative mental health spiral that can also affect their performance over time. The purpose of this longitudinal study among 881 first-year bachelor students is to explore the mechanisms by which loneliness, coping strategies in the context of COVID-19, mental health outcomes and procrastination sequentially mediate the relationship depression and anxiety on the one hand, and academic performance on the other hand. We measured mental health variables several times during the COVID-19 crisis and assessed how this translates into academic performance at the end of the academic year. By performing exploratory and confirmatory factor analyses, three high-order factors for the coping strategies in the context of the COVID-19 crisis were identified, namely maladaptive coping, adaptive coping, and supportive coping. Structural equation modeling was used to test the sequential mediational model. The results showed that maladaptive coping strategies employed at T2 during the lockdown, but not adaptive or supportive coping partially mediate the trajectories of depression (T1) and anxiety (T1). Loneliness (T2) partially mediated the trajectory of depression and anxiety (T1), and procrastination fully mediated the impact of depression (T3) on academic performance (T4). These results help understand the mechanisms that influence mental health and academic performance outcomes in response to the COVID-19 crisis. Based on the study outcomes, educational researchers can test strategies to reduce the adverse effects of stressful situations in learning environments by targeting maladaptive coping behaviors and procrastination.

Keywords: COVID-19, depression, anxiety, loneliness, coping strategies, academic performance, procrastination

INTRODUCTION

Since the start of the COVID-19 pandemic, many countries have taken restrictive measures and have implemented lockdowns in an effort to contain the spread of the virus. The pandemic and these restrictions have changed living conditions across countries and age groups, affecting social life and increasing mental health issues (Kumar and Nayar, 2020), which may even have caused people to experience grief over the loss of their normal lives (de Jong et al., 2020). In addition, authors have found various adverse side effects, including mental and physical health issues (for reviews see Schippers, 2020a,b).

For young people, the crisis and accompanying measures often have negative effects on their psychological well-being (Wang Z. H. et al., 2020). In the context of higher education, COVID-19 has affected more than 89% of higher education institutions in the world (IAU, 2020). Most of these institutions had to switch to online mode practically overnight, leading to a severe reduction in or even the elimination of in-person interactions. Furthermore, the pandemic has seriously impacted student's mental health and continues to do so (Tang et al., 2020; Wang C. et al., 2020; Fruehwirth et al., 2021). Before the pandemic started, research had shown that during the transition to higher education, students were already at risk of developing mental health issues (Hunt and Eisenberg, 2010; Auerbach et al., 2018), which in turn increased the risk of procrastination and academic underperformance (Bruffaerts et al., 2018). Although there is some consensus in the literature on the impacts of the pandemic on student's mental health, there are equivocal findings with regard to the question whether these impacts prevail after the lockdowns are released. One study found that easing restrictions does not have a significant impact on improving mental health (Pieh et al., 2021), e.g., while others found that mental health returns to baseline after releasing the pandemic restrictions (Meda et al., 2021). A large longitudinal study among 157,213 Americans (Yarrington et al., 2021) tracked the mental health outcomes during 5 months, from before the stay-at-home orders, up to two and a half months (on average) after the ease of the restrictions. They found a difference on the trajectories of anxiety and depression; where anxiety levels decreased, surprisingly, depression continued increasing after relaxing the stay-at-home orders. Although coping strategies were not measured, the authors theorized that coping may play an important role protecting against negative long-term mental health outcomes, as levels of anxiety returned to baseline after stay-at-home measures were relaxed, they speculated that this was caused by effective coping strategies. Thus, there is a strong need for more knowledge on how students cope with the situation, and how their coping relates to their psychological well-being and academic performance. The most important aims of this paper are therefore (a) to examine the effect of the COVID-19 crisis on psychological well-being and academic performance of students in higher education over time, (b) to examine the role of coping strategies and loneliness on psychological well-being, and (c) to assess the mediating role of procrastination between psychological well-being and academic performance. Furthermore, we examined the factor structure of coping strategies in the context of the COVID-19 crisis (see **Figure 1**). As coping strategies have been found to vary in their usefulness and how they associate with one another depending on the context (Krägeloh, 2011), this is to the best of our knowledge the first study to assess how the pandemic has influenced their aggregation in this new context and their integration into a more comprehensive model including mental health and academic performance outcomes. Greater insights into the different coping strategies that students apply in the context of the COVID-19 crisis and the relation between those coping strategies and students' mental health could help mental-health care professionals to offer a more tailored support to students.

THEORETICAL FRAMEWORK

The COVID-19 crisis has become a source of stress, which includes threats to human life and social disruptions, as the population has been forced to change their habits and patterns of behavior (Schippers, 2020b; Zhang et al., 2020). Although in terms of scale, this event is unprecedented, we know that these types of disastrous events are known to impact mental health, resulting in higher levels of depression (Norris et al., 2002). A recent meta-analysis by Bueno-Notivol et al. (2021) estimated that compared to the prevalence in 2017, the current crisis has produced an increase up to seven times in the levels of depression in the general population, as compared to the period before the lockdowns started. Ettman et al. (2020) came to a similar conclusion, reporting a threefold increase of depressive symptoms among the adult United States population. Furthermore, the changes to normal life have become a source of anxiety due to mobility restrictions, reduced social connections, fear for access to supplies, loss of family incomes, communication of conspiracy theories, and fear for individuals' health conditions and that of their families (Jakovljevic et al., 2020).

Additionally, COVID-19 increases the fear of contagion from social interactions, withdrawal from routine and loss of normalcy, as well as limited interactions even within closer social circles (Brooks et al., 2020). Prior research has shown that these types of disruptions are related to heightened loneliness, depression, and anxiety (Leigh-Hunt et al., 2017). Physical mobility restrictions like quarantining and social distancing are likely to be the drivers in increasing the perception of loneliness (Wilder-Smith and Freedman, 2020), as they may increase the discrepancy between desired and perceived social relationships (Perlman and Peplau, 1981). Additionally, the impact on social interactions has the negative drawback of affecting social connections, which are the building blocks for adaptive living and timely recovery after stressful experiences (Bonanno et al., 2007). As a result, the levels of loneliness, as well as the levels of depression and anxiety, have increased during the COVID-19 pandemic (Luo et al., 2012; Killgore et al., 2020; Palgi et al., 2020). Young people are particularly vulnerable to depression, anxiety, and loneliness (Groarke et al., 2020), which has been exacerbated by the COVID-19 pandemic (Liu et al., 2020). Thus, the accumulation of negative life events during this period, have deteriorated mental health and could increase the risk of underperformance

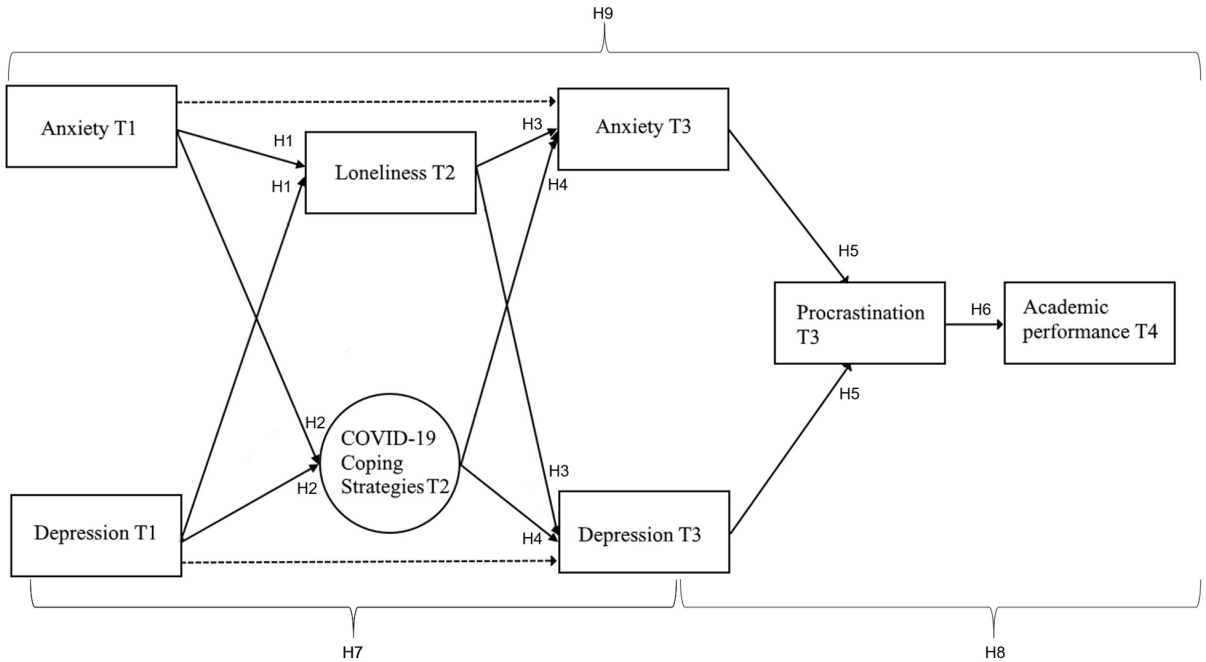

FIGURE 1 | Hypothesized sequential mediation model including the three higher-order coping strategies in the context of the COVID-19 pandemic.

under the current scenario (Brehl et al., 2021). Surprisingly, however, Gonzalez et al. (2020) found that the confinement has affected academic performance of Spanish students positively. They attributed this effect to changes in study behavior that make students work more continuously and uninterrupted. Also, they might have been relying on an increased feeling of intrinsic responsibilities when facing the new and unknown scenario that the confinement procedures formed. Thus, while for some students the lack of distraction may be helpful in terms of focus and academic performance, it is also conceivable that study performance decreases along with a deterioration of mental health. It could very well be that the coping mechanism employed by students plays a key role in determining the effect on academic performance. A widely used definition of coping is "constantly changing and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person" (Lazarus and Folkman, 1985, p. 141). To respond to stressful situations and adapt to changing environmental conditions, individuals can use different coping strategies. Coping strategies have been classified depending on their functionality to solve or evade the challenges: adaptive coping behaviors lean toward acknowledging the stressors, analyzing the situations, seeking support, and making efforts to solve the problems. In contrast, maladaptive coping behaviors lean toward avoiding the problems, withdrawal, and substance use to evade the sources of stress (Folkman and Moskowitz, 2004). However, higher order coping dimensions appear to be unstable and depend on the type of stressors and the sample (Campos et al., 2004).

A widely used scale to measure coping strategies is the Brief COPE (Carver, 1997). The Brief COPE is a shortened version of the COPE inventory (Carver et al., 1989), and it measures 14 different coping responses. However, there is not much consistency in the aggregation of coping strategies to form higher-order factors in the literature, as clusters up to nine factors have been found (Carver, 1997). Originally, coping strategies were categorized into two dimensions, namely problem-focused and emotion-focused coping, clustering into the emotion-focused factor strategies such as venting, behavioral avoidance, and substance abuse. Meanwhile, problem-focused coping strategies have included positive framing, planning, and active coping (Folkman and Lazarus, 1980; Moore et al., 2011). However, categories containing different strategies have been defined in other contexts. Later, a third dimension, maladaptive coping, was added to the previous two (Folkman and Moskowitz, 2004). This third dimension changed the configuration. Problem-focused strategies now included strategies such as taking actions and getting instrumental support, emotion-focused strategies included emotional support, acceptance, positive framing, and the use of religious beliefs, and finally, maladaptive strategies included behaviors such as denial, venting, substance use, and self-blame. However, in previous research it is suggested that the effectiveness of different coping responses is context-dependent (Lazarus and Folkman, 1985; Lazarus, 2000; David et al., 2006). Considering that in previous literature higher-order strategies, such as adaptive and maladaptive coping have found to be composed of different lower-order coping strategies depending on the context (Krägeloh, 2011), it would be advisable to run separate factor analyses and determine the factor structure in the context of the COVID-19 crisis, rather than relying on previously defined factors.

Indeed, prior research showed that coping is multidimensional, and it has been shown that it has both positive and negative dimensions. A negative dimension, categorized as maladaptive coping, which includes avoidant and emotion-focused strategies, and a positive dimension, categorized as adaptive coping, which includes active and problem-focused strategies (Groth et al., 2019). Even though in the past different models high-order factors have not been consistent (Snell et al., 2011), in general they have been consistent in their association to physical and mental health outcomes. Coping strategies have been found to play a role in predicting mental health outcomes over time (Thompson et al., 2018). While adaptive coping strategies such as planning and acceptance aid in solving the problems at hand, maladaptive coping fails to resolve stress sources, causing anxiety, and depression (Lazarus and Folkman, 1985). Another study found that maladaptive coping was a significant predictor of depression, anxiety, and stress, whereas adaptive coping did not significantly predict any of these variables among students (Mahmoud et al., 2012). In particular, maladaptive coping strategies have been linked to higher levels of depression (Heffer et al., 2014), and maladaptive emotion regulation strategies to anxiety during the COVID-19 crisis (Brehl et al., 2021). On the other hand, adaptive and instrumental or social coping strategies have been associated with better stress management and reduced negative mental health outcomes (Farley et al., 2005). In general, maladaptive coping strategies, such as withdrawal and substance abuse, seem to be adopted and increase in early adolescence, stabilizing at the end of the school years (Skinner and Saxton, 2019). The mechanism by which maladaptive coping strategies are likely to impact mental and academic outcomes is by preventing individuals from facing and solving the problems. As Beck and Clark (1997) proposed, negative mental outcomes are not directly caused by the stressors themselves, but by the individuals' perceptions of and reactions to those stressors. Thus, the outcomes are more a consequence of the individuals' skills to interpret and cope with the stressors. In this context, coping strategies could serve as tools to understand differing responses to challenges to manage stressful situations (Folkman and Moskowitz, 2004). Although the relationship between emotion-focused coping strategies and academic performance has been stablished (Thomas et al., 2017), we predict that this relationship is mediated by procrastination, due to its consequences on delaying taking actions upon challenges. This may be related to a negative downward spiral, in which people also develop a tendency to procrastinate.

Procrastination is defined as "the voluntary delay of an intended and necessary and/or (personally) important activity, despite expecting potential negative consequences that outweigh the positive consequences of the delay" (Klingsieck, 2013, p. 26). It has been found to be more prevalent in people with poor mental health (Stead et al., 2010), and has been associated with decreased academic performance (Kim and Seo, 2015; Tice and Baumeister, 2018). This impact on performance could be caused by assigning less time for working on the tasks (Buehler et al., 1994), not assigning time to act upon unforeseen obstacles, or an impaired performance caused by working under stressful situations (Baumeister, 1984). Students are particularly prone to procrastination, as prior research showed up to 50% of students perceived it as a cause of distress and difficulties (Day et al., 2000). Prior research has found a relation between procrastination and depression, and it has been theorized that it might be an outcome rather than a predictor of depressive mental states (Martin et al., 1996; van Eerde, 2003; van Eerde and Klingsieck, 2018). Procrastination is also related to higher levels of anxiety in students (Haycock et al., 1998), and it has been proposed that both anxiety and depression would make students more vulnerable to repetitive negative thoughts about past events, which in turn increases levels of procrastination (Constantin et al., 2018).

Whereas some studies have examined the relation between loneliness, anxiety, and depression, other mechanisms that facilitate the negative trend and their impacts on academic performance have often been overlooked. The current research aims to integrate these factors into a more comprehensive model in the context of the COVID-19 crisis while also incorporating the overlooked outcomes on academic performance by searching for a mechanistic explanation of the role of coping strategies and procrastination on these outcomes (see **Figure 1**). A better understanding of the role of individuals' strategies to respond to stressful situations and to perform academically would help improve students' tools to adapt to these situations and improve mental health and academic performance.

In the present study, two steps will be taken. First, we analyze the factor structure of the coping strategies during the COVID-19 pandemic. Based on previous literature findings, we expect to find at least two higher order coping factors, one positive and one negative. Second, we use longitudinal data to test a sequential mediation model to examining how the COVID-19 crisis affects psychological well-being and academic performance of first-year university students, as well as the mediating role of coping strategies and loneliness in this process. Furthermore, we examine the mediating role of procrastination between psychological well-being and academic performance.

Figure 1 gives an overview of the model and hypotheses tested in the current study. Based on previous findings we hypothesized a sequential model in which psychological well-being before the COVID-19 pandemic (T1) is related to perceived loneliness and coping strategies that students used at the beginning of the COVID-19 crisis (T2). These coping strategies and perceived loneliness should subsequently predict psychological well-being later in the academic year (T3), which might affect academic performance at the end of the academic year (T4), possibly mediated by procrastination (T3).

Hypothesis 1: Individuals with higher levels of anxiety and depression at T1 will have of higher levels of loneliness at T2.

Hypothesis 2: Individuals with higher levels of anxiety and depression at T1 will rely on more negative coping strategies at T2.

Hypothesis 3: Loneliness at T2 will be positively associated with anxiety and depression at T3.

Hypothesis 4: Maladaptive coping strategies at T2 will be positively associated with depression and anxiety at T3.

Anxiety and depression have been associated with higher levels of procrastination (Steel, 2007). Hence the following hypothesis:

Hypothesis 5: Higher levels of anxiety and depression will be associated with higher levels of procrastination at T3.

Considering the consequences of procrastinating behaviors and the irrational delay in initiating important activities, we also test the following hypothesis:

Hypothesis 6: Procrastination at T3 will be negatively associated with academic performance at T4.

Furthermore, we examine the mediating role of loneliness and maladaptive coping between psychological well-being at T1 and T3 with the following hypothesis:

Hypothesis 7: Loneliness and maladaptive coping at T2 partially mediate the relationships between anxiety and depression at T1 and anxiety and depression at T3.

Based on earlier found relationships between psychological well-being, procrastination, and academic performance, we also test the following hypothesis:

Hypothesis 8: Procrastination at T3 mediates between anxiety and depression at T3, and academic performance at T4.

Finally, if Hypotheses 1–8 are supported in the degree that it is possible to find sequential significant relations from the initial assessments to the outcome, it would suggest the following hypothesis:

Hypothesis 9: Loneliness and the negative coping strategies at T2, as well as anxiety, depression, and procrastination at T3 sequentially mediate between anxiety and depression at T1 in the initial stages of the COVID-19 pandemic, and academic performance at T4, at the end of the semester.

MATERIALS AND METHODS

Participants

Participants were 881 first year bachelor students of a Business Administration (BA) bachelor's degree program at a Dutch university. A total of 502 students followed the Dutch BA track, and 379 students were in the International Business Administration (IBA) track. The average age of the students was 18.58 years (SD = 1.28), and 59.7% was male. The curriculum was the same for both groups, except the language (Dutch or English). In consideration that the differences between groups were small in comparison with the scales' range (see **Supplementary Table A**), and that the results did not change significantly when analyzed in separate, the two groups were combined into one sample. When we repeated our main analyzes for the two groups separately, the results were also highly similar. The original number of students who participated in the program was 1533. We gave all students an informed consent at the start of the study. Of 395 students, consent data was incomplete, or they did not give consent, and 257 students did not complete any of the surveys that were needed for the present study. Therefore, our final sample for research purposes consisted of 881 students. Out of the 881 students in the total sample, 824 students responded to the questionnaires at T1 (468 BA and 356 IBA), 630 at T2 (326 BA and 304 IBA), and 460 at T3 (247 BA and 213 IBA).

Ethics Statement

The study was approved by the Internal Research Board of the university. Longitudinal data collection took place during a professional development course, which was a mandatory part of the curriculum. However, students were given the option to opt-out from having their data used for research purposes by either indicating this on their informed consent form, or by sending an email to the research team at any time during the study.

Procedure

The current study was part of a larger longitudinal project. Data collection took place in the context of a course focused on professional development that all first-year students followed throughout the academic year 2019–2020. The study originally comprised online surveys of several questionnaires across the academic year, that assessed psychological constructs, including depression, anxiety, and procrastination. In the second half of the academic year, the COVID-19 pandemic reached the Netherlands, and from March 2020 onward, restrictive measures were being taken to contain the virus. These included working from home and school and university closures. Students were given lectures online. For international students, this often meant they could not return to their home country during this time. In April, an extra questionnaire was sent out electronically to the students to assess how they were handling the situation. In this questionnaire, coping strategies and loneliness were assessed. Thus, data collection for the analyses of the current paper occurred over a 7-month period during the second half of the academic year (January to August). **Figure 2** provides a timeline of the different measurement occasions that were included in the present study.

Measures

Depression

Depression (T1 and T3) was measured using the Patient Health Questionnaire (PHQ-9), a short questionnaire aimed at assessing the severity of depression (Kroenke et al., 2001). Participants were asked to indicate how often over the last 2 weeks they had been bothered by nine different symptoms of depression such as "feeling down, depressed, or hopeless," or "feeling tired or having little energy." A 4-point scale was used, ranging from not at all to nearly every day. Cronbach's alpha was 0.87 at T1, and 0.9 at T3.

Anxiety

To measure anxiety (T1 and T3), we used the GAD-7, a brief seven-item questionnaire to assess generalized anxiety disorder

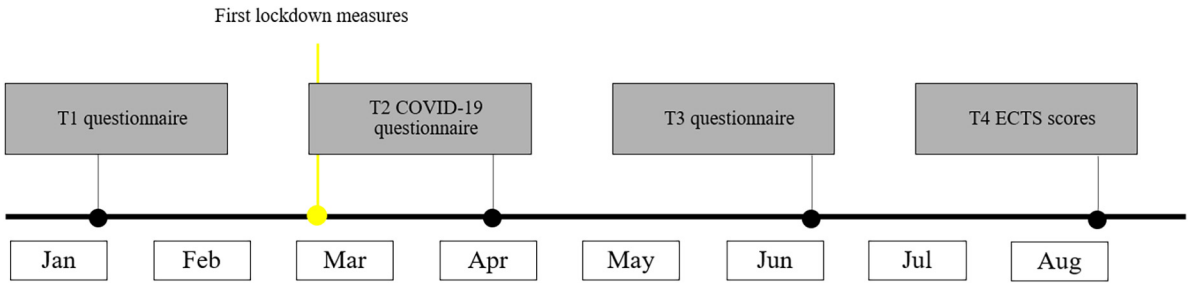

FIGURE 2 | A timeline of the measurements.

(Spitzer et al., 2006). Like for depression, participants were asked to indicate how often over the last 2 weeks they had been bothered by seven different symptoms of anxiety, such as "Feeling nervous, anxious, or on edge," or "worrying too much about different things." The questions were answered on a 4-point scale, ranging from not at all to nearly every day. In the current sample, Cronbach's alpha was 0.9 at T1, and 0.94 at T3.

Loneliness

Students' experienced level of loneliness since the start of the COVID-19 crisis was assessed at T2 (about a month after the start of the lockdown measures) using the six-item De Jong Gierveld Loneliness Scale (Gierveld and van Tilburg, 2006). This is a short version of the earlier 11-item De Jong Gierveld Loneliness Scale (de Jong-Gierveld and Kamphuls, 1985), which includes statements such as "I miss having people around," and "I miss having a really close friend." The six-item version has been shown to have good reliability and validity in previous research (Gierveld and van Tilburg, 2006). In the present study, the Cronbach's alpha was 0.68 (T2).

Coping With the COVID-19 Crisis

To measure coping, we used the Brief COPE (Carver, 1997) also at T2. The Brief COPE is a shortened version of the COPE inventory (Carver et al., 1989). It assesses 14 different coping responses (self-distraction, active coping, denial, substance use, use of emotional support, use of instrumental support, behavioral disengagement, venting, positive reframing, planning, humor, acceptance, religion, and self-blame), using two items per scale.

Literature suggests that the Brief COPE can be used to measure situational or dispositional coping (Carver and Scheier, 1994). Because of the specific and unusual circumstances, and because we were interested in how student cope with the current situation, we measured situational coping, targeted at the COVID-19 situation. The questionnaire was introduced with the instructional sentence "Since the start of the corona crisis, ..." The subscale self-blame was omitted, as the items did not seem suitable within the COVID-19 situation, as it seemed highly unlikely that students would blame themselves for the developed situation. Items were answered on a 5pt scale (not at all – a lot). In line with the recommendation by Eisinga et al. (2013) we assessed the reliability of the two-item (sub)scales using the Spearman–Brown coefficient rather than Cronbach's alpha as the later provides a less accurate estimate of reliability for two-item scales. Reliabilities of all subscales are shown in **Table 1**.

Procrastination

Procrastination (at T3, 3 months after the start of the lockdown and 2 months after the T2 questionnaire) was assessed with the Avoidance Reactions to a Deadline Scale (van Eerde, 1998), which includes items such as "I begin later than I had planned," and "I say to myself start now. And I still don't start." This scale consists of eight items that measure cognitive and behavioral acts when students are confronted with deadlines. Items were answered on a 5-point scale (Never – Always). The Cronbach's alpha in the current study was 0.88 at T3.

Academic Performance

Official university transcripts were collected for all participants after the first year (T4) in order to derive the number of obtained European Credit Transfer and Accumulation System or ECTS credits (0–60). One successful academic year corresponds to 60 ECTS credits, which translates to 1500–1800 study hours. In order to earn ECTS credits for a course, a student needs to achieve a passing mark for each course. The scale for the grades for each course varied from 1 to 10, with 1 meaning bad and a 10 being excellent. Students with a grade lower than 5.5 failed the course. This measure of academic performance is most predictive of later academic performance and proved to be a reliable predictor

TABLE 1 | Reliability of the scale scores for the Brief COPE.

Brief COPE subscale	Spearman–Brown coefficient
Self-distraction	0.20
Active coping	0.47
Denial	0.79
Substance use	0.85
Emotional support	0.80
Behavioral disengagement	0.43
Venting	0.50
Instrumental support	0.74
Positive framing	0.71
Planning	0.62
Humor	0.70
Acceptance	0.65
Religion	0.81

of incremental study progress in the European context (e.g., Schippers et al., 2013, 2015, 2020; Triventi, 2014).

Analytical Procedure

Prior to our main analyses, we conducted a second-order exploratory factor analysis (EFA) on the subscales of the Brief COPE in order to explore the different coping strategies in the context of the COVID-19 crisis. Using confirmatory factor analysis (CFA) we validated the resulting higher-order coping strategies. Once the best fitting factor solutions had been identified, the resulting higher-order factors were incorporated in our theoretical model (**Figure 1**). In order to test our main hypotheses, structural equation modeling (SEM) was applied to test the partially mediating role of the different higher-order coping strategies and loneliness on the relationship between depression and anxiety at T1 and T3. In addition, the model included the fully mediating role of procrastination on the relationship between depression and anxiety at T3 and academic performance at the end of the academic year (T4). The Lavaan package (0.6–7) in R was used (Rosseel, 2012) for the modeling procedure. To judge the model fit, different fit indices are reported (χ^2-value, χ^2/df ratio, CFI, RSMEA, and SRMR) following the recommendations of Schreiber et al. (2006) regarding the cut-off criteria. To avoid biased estimates as a result of non-response and in order to improve the validity of the statistical results, the modeling procedure made use of a "Full information maximum likelihood estimation" (FIML) for handling missing values (Enders and Bandalos, 2001). Note that missing data due to non-response on the different questionnaires was found to be either missing at random (MAR) or completely missing at random (MCAR) after eliminating outliers. To confirm the if the database met the MAR criteria, a regression-based approach using the RBtest library from R was run (Rouzinov and Berchtold, 2020). To test the statistical significance of the mediation effects (see section "Results") we additionally calculated the 95%-confidence interval (CI) with bias corrected standard errors using a bootstrapping approach with 5000 repetitions (Shrout and Bolger, 2002; Kline, 2015).

RESULTS

Descriptives

The means, standard deviations, and correlations for all variables and measurement occasions are displayed in **Supplementary Material**. Examination of the residual plots revealed that the assumptions of linearity and homoscedasticity were met for the observed variables. The standard deviation, mean scores, and bivariate correlations between all variables at each measurement occasion are presented in **Supplementary Table B**.

Outliers

Prior to the modeling procedure the data were scanned for possible multivariate outliers. To identify multivariate outliers the Mahalanobis distance was calculated, with a criterion of $p < 0.001$, which led to the detection of 98 multivariate outliers which were excluded from the analysis, leaving the total sample in 783 observations. However, the vast majority of those cases was detected due to missing data on multiple constructs. When calculating the Mahalanobis distance for only those cases with complete data on all variables and measurement occasions only 13 cases were found to be outliers.

Factor Structure of Brief COPE

In order to reduce the number of factors and create a more parsimonious model, we performed a second-order EFA. The results of this EFA are presented in **Table 2**. As expected, and in line with the literature, three distinct second-order factors with an eigenvalue over 1 were identified.

Based on the criteria of factor loadings above 0.4 (Guadagnoli and Velicer, 1988), the resulting factors consisted of the following sub-scales. Factor 1, adaptive coping, includes the scales of positive framing, planning, and active coping. Factor 2, supportive coping, includes the scales of instrumental support and emotional support. Factor 3, maladaptive coping, includes the scales of denial, behavioral disengagement, venting, substance use, and acceptance (reverse coded). Humor and religion did not load above 0.3 in any of the three predicted factors. Therefore, these scales were left out of the analyses. The acceptance sub-scale was reverse coded because its highest load was −0.475 in Factor 3. By doing this, we made sure that all the factor loadings for each sub-scale were in the same direction, and hence this scale represents "non-acceptance."

Although some of the first-order scales showed reliabilities below the recommended value of 0.7 (Nunnally, 1994), we considered the issues that have been found with two item scales (Eisinga et al., 2013) and assessed the composite reliability of the second-order factors, including all the scales with a factor loading above 0.4. We found that each of the three factors reached an acceptable-to-good Cronbach's alpha. For Factor 1 Cronbach's alpha was 0.76, for Factor 2, 0.86, and for Factor 3, 0.75. Note that none of the composite reliabilities of the three factors would have

TABLE 2 | Summary of the second-order exploratory factor analysis of the coping strategies.

COPE subscales	Factor 1	Factor 2	Factor 3
Planning	**0.682**	0.321	0.05
Positive framing	**0.63**	0.165	−0.043
Active coping	**0.56**	0.143	−0.077
Self-distraction	0.361	0.170	0.124
Instrumental support	0.222	**0.951**	0.204
Emotional support	0.365	**0.653**	0.115
Denial	0.123	0.071	**0.67**
Behavioral disengagement	0.015	0.092	**0.601**
Venting	0.249	0.321	**0.52**
Substance use	−0.014	0.052	**0.452**
Non-acceptance	0.344	0.039	**0.475**
Humor	0.281	0.012	0.102
Religion	0.108	0.131	0.162

n = 623. Rotated factor loadings over 0.40 appear in bold. Eigenvalues after the extraction = 1.063. Percentage of variance 38.8%.

improved if any of the included subscales were dropped from their respective second-order factors.

Next, a CFA was applied to validate the results of the EFA. For this analysis, we included only those subscales that loaded high on any of the three distinct factors that were found in the EFA.

Using the maximum likelihood method, we estimated the model fit using the χ^2/df ratio, CFI, RMSEA, and SRMS. The models' *p*-value was not considered, as the typical Chi-square for large samples is not significant. To analyze the fit of the models, we used the criteria of CFI > 0.90, RMSEA < 0.08, SRMR < 0.08, and χ^2/df < 3 (Hooper et al., 2008; Iacobucci, 2010).

An initial test of the three-factor model indicated a less than acceptable fit with the following parameters: χ^2 = 238.89, χ^2/df = 7.46, CFI = 0.875, RMSEA = 0.102, and SRMR = 0.087. The examination of the standardized residuals and modification indices suggested adjusting the model by incorporating the non-acceptance factor as a latent variable to support coping and adaptive coping. As the loading factor of non-acceptance in the CFA was low (0.34), and the loading of a given variable in more than one factor is not advisable for structural models, we eliminated the non-acceptance variable from the model. The new model resulted in: χ^2 = 109.11, χ^2/df = 4.54, CFI = 0.943, RMSEA = 0.075, and SRMR = 0.053, showing a significant improvement in all the criteria. Finally, a new examination of standardized residuals and modification indices suggested to permit the correlation of errors between emotional support – positive framing and denial – behavioral disengagement. This definitive model resulted in: χ^2 = 70.66, χ^2/df = 3.21, CFI = 0.967, RMSEA = 0.06, and SRMR = 0.047, meeting all the fitting criteria. The results of the three-factor solution are presented in **Figure 3**.

The definitive three-factor model reached a much better fit than the two-factor model considering problem-focused and emotion focused coping: χ^2 = 810.307, χ^2/df = 15.28, CFI = 0.573, RMSEA = 0.151, and SRMR = 0.120, or the three-factor model that also distinguishes dysfunctional coping: χ^2 = 541.06, χ^2/df = 10.6, CFI = 0.724, RMSEA = 0.124, and SRMR = 0.097.

To conclude, the three second-order factors, denominated adaptive, supportive, and maladaptive coping, were used in the next steps of our analyses, confirming our expectation of finding at least one negative and one positive higher order factor.

To conclude, the three second-order factors, denominated adaptive, supportive, and maladaptive coping, were used in the next steps of our analyses, confirming our expectation of finding at least one negative and one positive higher order factor.

Sequential Model

For the modeling procedure we employed a model generation approach as outlined by Kline (2015). In that fashion we tested out initial theoretical model but allowed for several iterations of further model specification in the case of unsatisfactory model fit. The respecified model was then tested again with the same data. As described by Kline (2015), while not strictly confirmatory in the narrowest sense, the model generation approach is the most common approach and follows the goal of finding a model that makes theoretical sense, is reasonably parsimonious and in close correspondence to the data.

Following this approach led to four iterations of model re-specification. The resulting five models are described subsequentially in the following section. The fit coefficients for all five models are presented in **Table 3**.

Model 1 – the initial model

Our initial model (**Figure 1**) consisted of two exogenous variables at T1, anxiety and depression, modeling the partial mediation of loneliness and the three coping factors identified during the CFA, and the resulting anxiety and depression variables measured at T3. This original model also included the mediating role of procrastination between depression and anxiety at T3, and the academic outcomes as number of credits approved at the end of the semester. Due to the complexity of the model only the higher-order coping strategies were estimated as latent factors. For all other constructs in the model the mean scores were used as manifest variables. This considerably reduced the number of parameters that had to be estimated and allowed for model convergence. The initial model tested the mediating role of loneliness and the three coping strategies on the levels of anxiety and depression from T1 to T3 as well as the mediating role of procrastination in the relationship between depression and anxiety at T3, and study performance at T4. Model 1 resulted in non-significant paths for adaptive coping, and for the direct relation between anxiety at T3 and procrastination at T3. The model did not reach any acceptable fit indices at this point (χ^2/df = 7.47, CFI = 0.755, RMSEA = 0.095, SRMR = 0.120).

Model 2

The second model eliminated all the non-significant adaptive coping paths from the analysis, resulting in a model where the supportive coping factor lost significance in the depression path. The model did not reach any acceptable fit indices at this point (χ^2/df = 7.81, CFI = 0.800, RMSEA = 0.097, SRMR = 0.103). Modification indices suggested to allow the error terms of denial and behavioral disengagement to covariate. As they were measured at the same time, and are part of the same latent variable, it was added to model 3.

Model 3

The third model eliminated the non-significant path of supportive coping in the depression path, resulting in a model where the supportive coping lost significance in the anxiety path. The model did not reach any acceptable fit indices at this point (χ^2/df = 7.35, CFI = 0.810, RMSEA = 0.094, SRMR = 0.094). Modification indices suggested to allow the error terms of maladaptive coping and loneliness to covariate. As they were measured at the same time, it was added to model 4.

Model 4

The fourth model eliminated the non-significant path between anxiety and supportive coping, eliminating all the contributions of supportive coping and consequently removed the factor from the model. The model did not reach any acceptable fit indices at this point (χ^2/df = 5.18, CFI = 0.887, RMSEA = 0.076, SRMR = 0.062). Modification indices suggested to allow the error terms of depression and anxiety to covariate. Thus, as they were

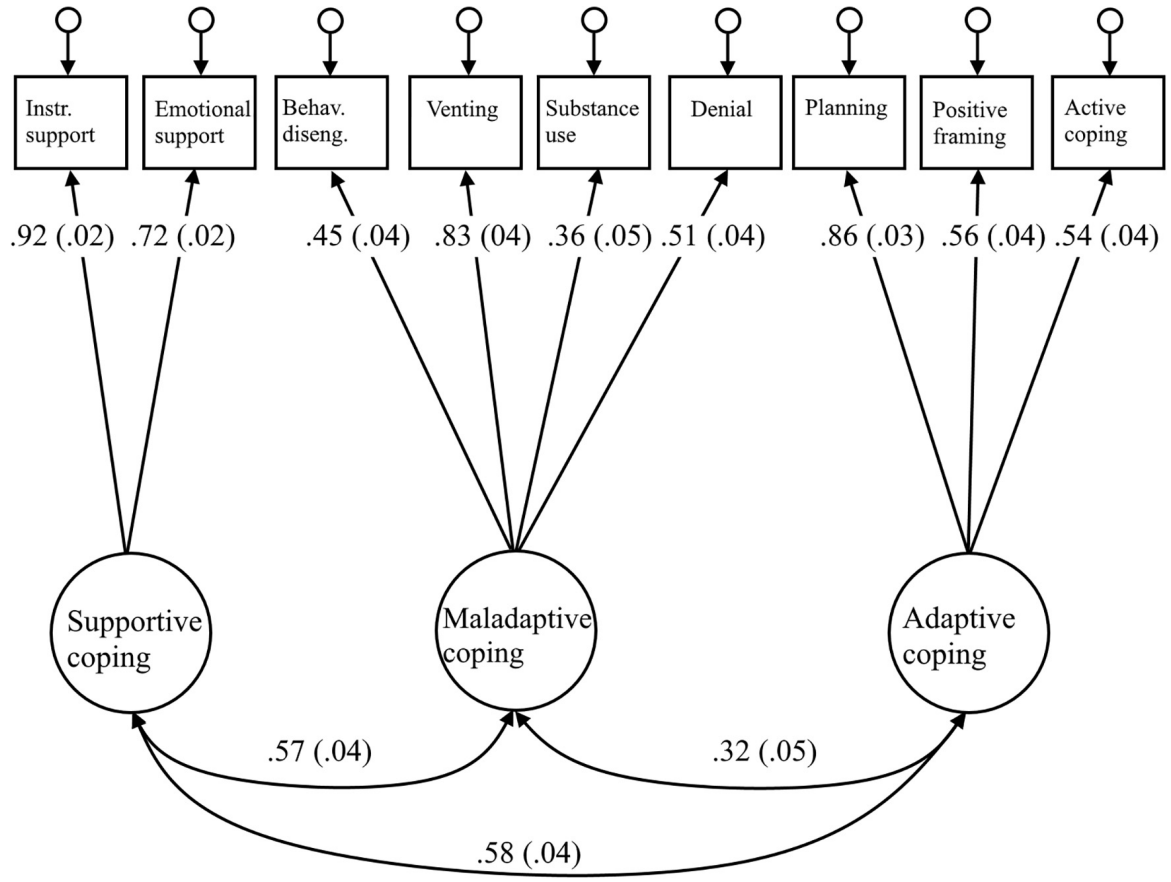

FIGURE 3 | Three-factor solution for coping. Behav. diseng, behavioral disengagement; Instr. support, instrumental support. All loadings are significant at $p < 0.05$. Standard errors are reported in parentheses. Model fit: $\chi^2 = 70.66$, $\chi^2/df = 3.21$, CFI = 0.967, RMSEA = 0.06, and SRMR = 0.047.

measured at the same time, depression and anxiety at T1, and at T3 were allowed to covariate and added to model 5.

Model 5

In order to create a more parsimonious model, the fifth model kept all the significant paths between depression, anxiety, loneliness, maladaptive coping, procrastination, and academic performance, eliminating all non-significant paths among them. This model reached excellent fit indices ($\chi^2/df = 2.67$, CFI = 0.971, RMSEA = 0.046, SRMR = 0.040), and its path coefficients are shown in **Figure 4**.

The results obtained in model 5 confirm our expectation for Hypotheses 1 and 2, as higher levels of anxiety and depression at T1 were found to be related with higher levels of loneliness (H1) and maladaptive coping (H2) at T2. Hypotheses 3 and 4 were also supported, as both loneliness (H3) and maladaptive coping (H4) at T2 were significantly associated with higher levels of anxiety and depression at T3. For Hypothesis 5, the expectation was only partially supported, as only depression, but not anxiety at T3 was significantly correlated with procrastination at T3. As the final step in checking the individual relations, Hypothesis 6 was also supported by the negative but significant relation between procrastination at T3 and academic performance at T4.

When looking at the mediation hypotheses, results generated by 5000 iterations of bootstrapping (Shrout and Bolger, 2002) indicate that loneliness at T2 partially mediated from depression at T1 to depression at T3 (indirect effect = 0.054, bias-corrected bootstrap 95%-CI 0.022–0.101), and from anxiety at T1 to anxiety at T3 (indirect effect = 0.025, bias-corrected bootstrap 95%-CI 0.005–0.061). Maladaptive coping at T2 partially mediated from depression at T1 to depression at T3 (indirect effect = 0.069, bias-corrected bootstrap 95%-CI 0.018–0.161), and from anxiety at T1 to anxiety at T3 (indirect effect = 0.053, bias-corrected bootstrap 95%-CI 0.011–0.135). Thus, it was supported that loneliness and maladaptive coping at T2 partially mediate between anxiety and depression at T1 and T3 (H7), even in the presence of a direct path between anxiety and depression at T1, and anxiety

TABLE 3 | Model fit coefficients for the structural equation models.

	χ^2	χ^2/df	CFI	RMSEA	SRMR
Model 1	664.98	7.47	0.755	0.095	0.120
Model 2	421.90	7.81	0.800	0.097	0.0103
Model 3	404.59	7.35	0.810	0.094	0.094
Model 4	181.55	5.18	0.887	0.076	0.062
Model 5	90.81	2.67	0.971	0.046	0.040

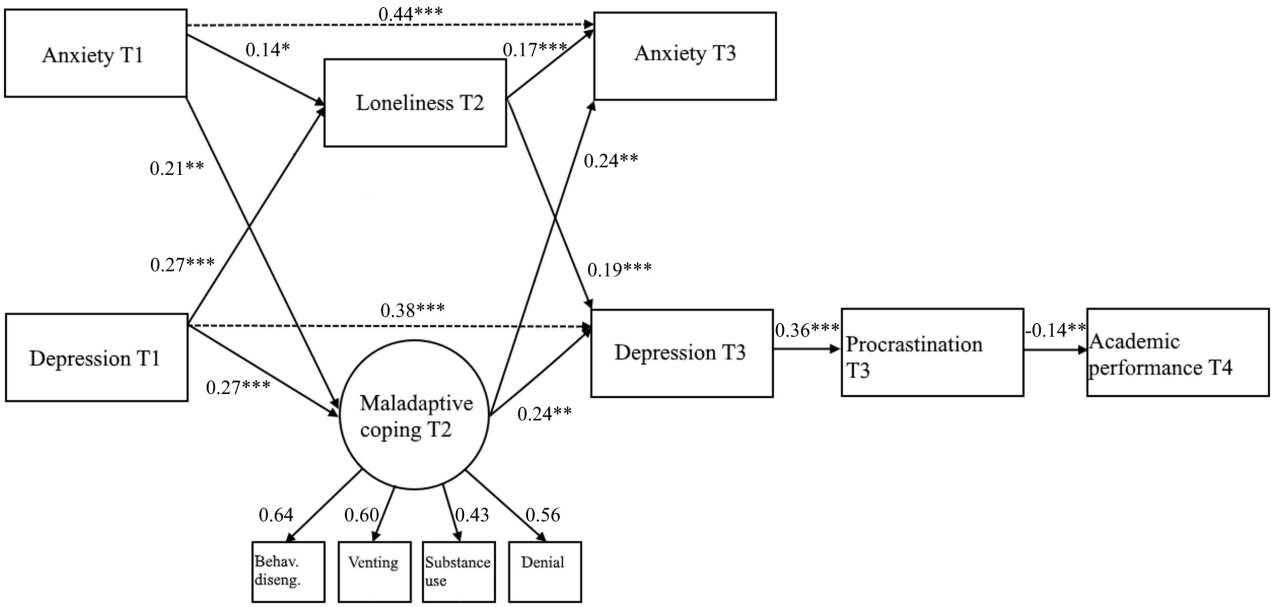

FIGURE 4 | Final model (model 5) with path coefficients and factor loadings. Behav. diseng, behavioral disengagement. Values represent standardized path coefficients. Covariances and error terms not included for clarity $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

and depression at T3. The second mediation hypothesis test also resulted in a significant mediation of procrastination at T3, between depression at T3 and Academic performance at T4 (H8). Although unexpected, the lack of significance in the relation between anxiety and procrastination could be explained by the high correlation between anxiety and depression. This assumption was confirmed by assessing an alternative model that tested the significance of the relation between anxiety and procrastination at T3 in the absence of depression at T3, which resulted in a significant positive correlation. However, this model had worse fit that the definite model 5 and for this reason we decided to keep the model that fully mediates academic performance at T4 and depression at T3 *via* procrastination at T3.

Finally, as Hypotheses 1–8 were supported, allowing to find significant sequential relationships from the initial assessments at T1 to the outcome of academic performance at T4, we found significant support for the hypothesis that loneliness and negative coping strategies at T2, as well as depression and procrastination, but no anxiety at T3 sequentially mediate between anxiety and depression at T1 and academic performance at T4 during the COVID-19 pandemic (H9).

DISCUSSION

Coping with difficult situations is highly important in all situations and become even more important during the COVID-19 crisis. In the current study we showed that maladaptive coping strategies and loneliness play a significant role in the trajectory of mental health outcomes, and how these outcomes impact on academic outcomes through the mediation of procrastination in undergraduate management students during the COVID-19 pandemic. Maladaptive coping strategies in the form of denial, substance use, behavioral disengagement, and venting increased the levels of anxiety and depression after the lockdown restrictions started. Higher levels of depression, in turn, increased the levels of procrastination, impacting academic performance negatively.

The results of this study extend the findings in the literature, offering a theoretical explanation for the role of coping strategies, loneliness, and procrastination in the trajectory of anxiety and depression over time during the COVID-19 pandemic. First, we found supporting evidence of a high order three-factor configuration for coping styles using the Brief COPE questionnaire, identifying three groups of coping strategies that we denominated adaptive coping (planning, active coping, and positive framing), supportive coping (emotional and instrumental support), and maladaptive coping (denial, substance use, behavioral disengagement, and venting). In addition, the fact that the higher-order factor (supportive coping) combined emotional and instrumental support was in line with the studies by Carver (1997) and Farley et al. (2005), concerning the Brief COPE, and Carver et al. (1989), concerning the original COPE scale. Second, we tested the role the three high-order factors of coping in the trajectories of mental health outcomes, finding that only maladaptive coping partially mediates the subsequent changes in the levels of depression and anxiety. Third, the results reveal that loneliness during the pandemic is a significant partial mediator of the subsequent changes in the levels of depression and anxiety. Fourth, the study shows that procrastination is a significant mediator between the later levels of depression and the academic performance of students.

The lack of significance of adaptive and supportive coping with depression and anxiety during the COVID-19 pandemic

suggests that the most important drivers for negative mental health outcomes are the maladaptive coping behaviors, which is in line with the findings by Groth et al. (2019), who found that maladaptive, and not adaptive coping was significantly associated with anxiety and depression during "normal times." The significant relationship from maladaptive coping to depression shows that people that engage in challenge-evading behaviors end up with higher levels of depression. Indeed, the dimensions that form maladaptive coping have broad implications in acting on non-contributing manners to adjust and respond to emotional stressors, offsetting the adaptive and supportive coping strategies' potential positive contributions. Thus, interventions aimed at reducing depression and anxiety among students should emphasize reducing maladaptive coping strategies to modify the negative consequences of maladaptive behaviors.

The role of loneliness as a mediator for anxiety and depression confirms that the mismatch between expected and real social connection can cause higher levels of negative mental outcomes (Palgi et al., 2020). This outcome enhances the necessity to focus on different options to prevent social isolation and increase the awareness of the benefits of social connections. In the context of COVID-19 some of the options could be to make restrictions of social gatherings more flexible if the health prevention measures can be implemented, or to promote the creation of "safe social bubbles" where a group of people with more controlled external interactions can gather with a limited number of people as long as everybody respects the health-preventive recommendations (Leng et al., 2020).

In line with previous findings from DeRoma et al. (2009) and Owens et al. (2012), we found that higher levels of depression are significantly associated with lower academic performance, and that procrastination is a significant mediator of this relationship. Thus, it could very well be that higher levels of depression would trigger more procrastination, postponing the initiation of duties and impacting the final quality of the academic performance. This is particularly important in the context of the COVID-19 crisis, as the levels of depression have increased up to sevenfold (Bueno-Notivol et al., 2021). Among the two mental health outcomes, only depression was found to be significantly correlated with academic outcomes, and this association is significantly mediated by procrastination. At first glance, this suggests that depression and not anxiety prevents people from taking effective actions toward a better performance. As discussed by Eysenck et al. (2007), anxiety may not always result in impaired performance. Besides reducing cognitive control, anxiety also heightens attention to threat stimuli, which in the presence of compensatory strategies like increase in effort and process resource could prevent negative outcomes. However, the analysis of an alternative model in our study shows that in the absence of depression, anxiety can also significantly predict procrastination and lower academic performance, which is consistent with the literature that found that both anxiety and depression can contribute to procrastination (Haycock et al., 1998; Constantin et al., 2018).

Our study and research model integrate the knowledge of the inter-relation between loneliness, coping strategies, procrastination, mental health outcomes and academic performance during the COVID-19 crisis. The advantage of creating a model using SEM is that it allows to perform direct tests of the theory while giving some control of the measurement errors. The resulting structural model offers possible intervention targets at different stages. Based on the longitudinal nature of the observations, it would be theoretically possible to improve the mental health outcomes of depression and anxiety by intervening in the maladaptive coping strategies and the level of loneliness before the appearance of negative mental health outcomes. On the other hand, to improve the academic outcomes, it would be possible to intervene in an early stage to reduce the perceived levels of loneliness and the maladaptive cooping behaviors, or in a later stage, by targeting students' procrastination habits.

STRENGTH, LIMITATIONS, AND FUTURE DIRECTIONS

An important strength of this study is that we used a large sample and that we started our surveys before the first lockdown occurred. Moreover, we measured our relationships using a longitudinal design, including measuring anxiety and depression at more than 1 point in time while measuring academic performance at the end of the academic year. The combination of a repeated measurements design, and the events in response to the COVID-19 pandemic have allowed us to work with a robust model to better understand the relationships between negative mental health outcomes, loneliness, coping strategies, and academic performance in students.

Despite the advantages of using large and longitudinal samples and a method that allows to test complex theories it should be mentioned that the causal inferences derived from the structural equation models do not include a control group. For obvious reasons, we were not able to test how a group of students would fare without a lockdown. Another limitation is that except for academic performance, all our data relies on self-reports. Even though our sample included a wide representation of international and Dutch students, it was limited to students in the university population. Future research could examine the relative importance of these variables analyzed in a context other than higher education, other crises, and possibly also in relatively "normal" times, and not in a crisis context. Although a longitudinal design has many advantages, a notable disadvantage is the risk of non-response of the participants at any point of the study, which could threaten the validity of the results. In this case, although there was a reduction in the number of participants from T1 to T3, the sample met the "Missing At Random" criteria (Seaman et al., 2013), which allows handling missing data in a statistically valid manner and allows using the FIML to produce unbiased estimates using the data of participants that did not complete all three surveys (Enders, 2013).

The overall result of a non-significant role of adaptive and supportive coping strategies is not surprising, as other studies have found that maladaptive coping and not adaptive or supportive coping are mediators of negative mental health outcomes (Groth et al., 2019). Still, it does not mean that they don't have a role in academic outcomes, but the effect is not

via a path of depression and anxiety. Based on prior literature, we would expect that adaptive and supportive coping play a more significant role in the context of happiness and/or more positive mental health outcomes (Meyer, 2001). Future studies could explore the mediating role of adaptive and supportive coping, both, in the COVID-19 and other contexts. Future research could also focus on ways to enhance more adaptive and supportive coping. For instance, interventions that trigger more positive forms of coping, based on the broaden and build theory (Fredrickson, 2001, 2004), might help. The broaden and build theory posits that experiences of positive emotions can increase the repertoire of thought-actions in individuals, also building their personal resources skillsets, including physical, intellectual, social, and psychological skills. In practice, it may help people come out of a downward spiral of negative emotions, and more into an upward spiral of positive emotions (Schippers and Ziegler, 2019). A promising intervention in this respect is life crafting, a process in which people actively reflect on different aspects of their current and future life and undertake actions to change the areas in a way that aligns with their passions, values, and wishes (Schippers and Ziegler, 2019; de Jong et al., 2020). In this online and scalable intervention, students write about all aspects of their life, and they are asked to write about the ideal life if there were no constraints and to contrast this with their expected life if nothing changes. In a second part of the life crafting intervention, they are asked to make concrete plans, order these plans from most important to least important and to make back-up plans. The advantage of this intervention is that it is inexpensive and scalable to a large number of students. Additionally, an app or chatbot with such an intervention could even add more value in terms of student well-being (Dekker et al., 2020). Other interventions, that could be used in combination with life crafting, are counseling and exercises as means to alleviate symptoms of stress, anxiety, and depression in university students (Byars, 2005).

Having scalable interventions to improve mental health and academic performance is important to reach a large number of individuals. Schippers and Ziegler (2019, p. 12) state that:

"Given the relatively low amount of costs and administrative work that the implementation of the outlined life crafting intervention entails, especially when compared to the potential benefits, we recommend its inclusion in student's curriculums. Getting many (young) people to take part in an online life crafting intervention may be an important step in achieving not only higher academic performance, but also better well-being, happiness, health, and greater longevity (see Schippers et al., 2015). Using technology to assist with life crafting *via* a goal-setting intervention seems to be a particularly promising avenue as this is an approach that can be easily scaled up."

These results are important not only for the academic context, as the integration of the role of maladaptive coping strategies in the relationship between loneliness, depression, and anxiety can be beneficial for the research of mental health in any context. The process of engaging in maladaptive coping behaviors appears to have a significant effect in increasing the levels of anxiety and depression.

CONCLUSION

In our study we showed how coping strategies and loneliness mediate the changes in depression and anxiety in first year bachelor students, and how in turn, procrastination bridges from these negative mental health outcomes to worse academic performance. We hope that this comprehensive model will help targeting interventions to improve mental health in students, as well as rising awareness about the behavioral mechanisms that impact academic outcomes. We anticipate that focusing on loneliness, maladaptive coping strategies, and procrastination will improve mental health in students while improving academic performance during the COVID-19 crisis. The advantage of an integrative model is that it allows to understand the potential connection between behaviors such as procrastination, coping skills, and academic and mental health outcomes. Understanding how these factors affect each other offers the opportunity to identify individuals that might suffer from depression or anxiety and implement interventions to reduce their perceived levels of loneliness, expecting to reduce their levels of depression and anxiety while increasing their academic performance.

Universities have had to make complicated decisions to transition toward virtual education without having a clear idea of the impacts of these decisions on students' mental health. This study revealed some of these unintended consequences on their students and provides an opportunity to counteract the negative outcomes, e.g., by providing virtual counseling support (Lee et al., 2021), or explore new ways to promote connection among students (Stuart et al., 2021). Thus, reducing the feelings of loneliness and creating awareness of the importance of effective coping skills. Promising interventions such as life crafting and well-being apps could potentially become part of the student's curriculum, as the mental health and academic benefits far outweigh the costs (Schippers et al., 2015, 2020; Schippers and Ziegler, 2019; Dekker et al., 2020).

We hope that our findings inspire subsequent studies that open other potential avenues to understand the inter-relation of other positive and negative mental health paths to improved performance in academic and more general settings. The availability of this type of models can serve not only universities, but also governments and policymakers to identify more effective targeted interventions in order to buffer the downstream unintended consequences of health and social policies.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Rotterdam School of Management internal research board. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SF wrote the initial draft of the manuscript and ran the majority of the statistical analyses. SF and NZ were involved in the analytical process and, revision and interpretation of the results. SF, NZ, and EJ contributed to the preparation of the raw data and the restructuring and revision the manuscript. MS provided the intellectual feedback and contributed to different versions of the manuscript. All authors were involved in the conception and design of the study, agreed to all aspects of the manuscript, and approved the final version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.682684/full#supplementary-material

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Rethinking the Multidimensionality of Growth Mindset Amid the COVID-19 Pandemic: A Systematic Review and Framework Proposal

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Students, staff, and faculty in higher education are facing unprecedented challenges due to the COVID-19 pandemic. Recent data revealed that a good number of academic activities and opportunities were disrupted as a result of the COVID-19 pandemic and its variants. While much uncertainty remains for the next academic year, how higher education institutions and their students might improve responses to the rapidly changing situation matters. This systematic review and framework proposal aim to update previous empirical work and examine the current evidence for the effectiveness of growth mindset interventions in young adults. To this end, a systematic search identified 20 empirical studies involving 5, 805 young adults. These studies examined growth mindset within ecologically valid educational contexts and various content areas. Generally, these findings showed that brief messages of growth mindset can improve underrepresented students' academic performance and facilitate other relevant psychological constructs. In addition, we argue, although growth mindset has been identified as a unitary concept, it is comprised of multiple interdependent skills, such as self-control, self-efficacy, and self-esteem. Understanding the nature of growth mindset may contribute to successful mindset implementation. Therefore, this article presents a practical framework to help educators in higher education rethink the multidimensionality of growth mindset and to provide their students with alternative routes to achieve their goals. Finally, additional articles were discussed to help evaluate growth mindset interventions in higher education.

Keywords: growth mindset, resilience, higher education, emotion regulation, mental health, self-regulation, self-efficacy

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INTRODUCTION

Students' growth mindsets—how malleable they perceive their abilities to be—play a pivotal role in their academic achievement (Dweck, 2006; Yeager and Dweck, 2020) and have been linked to multiple positive outcomes, including improved mental health (Schroder et al., 2017b), decreased stress (Burnette et al., 2020a) and even brain activity (Schroder et al., 2014). The extent to which and how growth mindset modulates one's achievement has been descriptively examined but rarely systematically explored (but see Cheng et al., 2021 for a review). The current systematic review and framework proposal aims to identify previous empirical work and examine the current evidence for the effects of growth mindset interventions in young adults, and to propose a practical framework that introduces educators of today to better support their learners.

Currently, academics around the world are facing the ongoing impact of an unprecedented situation—COVID-19, which has been disrupting academic activities and in-person interactions (García-Morales et al., 2021; Rodríguez-Planas, 2022). These unexpected challenges may be chronic stressors and long-term risk factors to retention and graduation goals, especially for at-risk college students (Rodríguez-Planas, 2022). In such difficult, yet unavoidable moments, mindset can play a crucial role in the future trajectory of learning (Schroder et al., 2017a). Behavioral strategies and cognitive trainings (or interventions) for enhancing growth mindset have gained increased attention (Broda et al., 2018), in part due to rising levels of anxiety in young adults (Schroder et al., 2019).

The first aim of this paper is to update previous empirical work and examine the current evidence for the effects of growth mindset interventions in young adults of higher education. In addition, this paper examines unique themes that the studies address and commonalities shared. The second aim of this study aims to contend that growth mindset is not a unitary concept but rather is multifaceted. The overarching concept of growth mindset may be too broad and fail to capture the nuances of the sub-abilities of growth mindset. Additionally, the concept of growth mindset may also be too somewhat abstract to implement in practice. Therefore, developing and maintaining the sub-abilities associated with growth mindset can be seen as prerequisites to successful learning and psychological wellbeing. Our proposal adds to the current literature in that we have not only suggested instructional strategies but also distinguished between the relevant sub-abilities in terms of how they differ and how each concept can be instilled in young adults.

By understanding the underpinnings of growth mindset sub-abilities, researchers and educators can better focus on ways to develop more successful interventions. Furthermore, educational institutions can then be positioned to provide students with the support they need to flourish and succeed despite periods of physical isolation and limited access to traditional psychotherapies (Hood et al., 2021).

What Is Growth Mindset?

A growth mindset embodies the thought that one's personal attributes, such as intelligence, skill, and ability can be developed and improved through effort. Mindset theory (Dweck, 1946; Dweck and Leggett, 1988) was originally derived from attribution theory and achievement goal theory in motivational research. Specifically, mindset effects are meaningfully heterogeneous across persons and situations (see Yeager and Dweck, 2020 for a discussion). Mindsets are typically evaluated by gauging individuals' agreement or disagreement with some statements on his or her capability to change or thrive in the face of challenges. Importantly, individuals can be at different points of the continuum at different times.

Compared to cognitive ability, this non-cognitive skill asserts that intelligence can be malleable (i.e., incremental theory) as opposed to fixed (i.e., entity theory). This malleability of mindset has been demonstrated to encourage people to think flexibly so they are not discouraged as easily in challenging situations (Dweck, 2006). A major question in social sciences is why some people tend to persist after failure and frustration while others succumb to setbacks immediately and never recover. Motivation has been closely associated with implicit theories of intelligence (Dweck, 2006). Implicit theories of intelligence entail a belief that personal characteristics such as one's intelligence and ability can be changed and developed later in life through effort and hard work. Such mental state is frequently called "growth mindset." However, individuals with a fixed mindset do not think that human traits and characteristics can be intervened with and altered. In other words, personal traits and characteristics are pre-determined and innate (see Dweck, 2006 for details). Relevant studies investigated underlying beliefs these students have about intelligence and learning. These individuals' views of themselves have been shown to ultimately influence their academic performance, motivation, behavior, and self-efficacy (Rhew et al., 2018).

Incremental implicit theories are closely associated with a growth mindset (Dweck et al., 1995). It is proposed that people can either embrace an entity theory or an incremental theory of their personal characteristics. Individuals with an entity theory think that they are incapable of changing most of their personal traits (e.g., strengths). On the contrary, individuals with an incremental theory would expect changes and improvements in their personal traits (Dweck and Leggett, 1988). Moreover, individuals with an entity theory or a fixed mindset seem to emphasize performance goals or outcomes of their actions. By contrast, those with an incremental theory or a growth mindset tend to focus on learning goals or processes, which has been considered to increase learner motivation (Dweck, 1986). Thus, learners with a growth mindset tend to be more intrinsically motivated to learn and to apply different strategies to learning compared to learners with a fixed mindset (Yan et al., 2014). However, it should be noted that growth mindset and fixed mindset are just the two ends of a continuum, which means that individuals can possess varying degrees of a mindset under different circumstances (Haimovitz and Dweck, 2017). It is important to note that mindset can be dynamic, ever-changing, and subjective although it has been assessed in a more static manner. The following review addresses growth mindset interventions and explores its effects on the outcome measures.

Why Is It Important?

Since the outbreak of the COVID-19, educational interventions have attracted increased attention in higher education (Adedoyin and Soykan, 2020; Yeo et al., 2021). Growth mindset interventions are often considered light-touch interventions (Kim et al., 2022) and are a common intervention to address both education (2022) and mental health needs related to the pandemic (Mosanya, 2021). In the current study, we examined the effectiveness of the growth mindset intervention and its contexts of implementation within higher education.

A growth mindset intervention explicitly teaches that individual's academic and intellectual abilities have the potential to develop and grow. A growth mindset intervention encompass the instructional delivery and/or discussion of potential concrete actions and strategies a learner can take to implement a growth mindset (Yeager and Dweck, 2020).

Growth mindset research develops out of the social cognitive theory (Bandura, 1986) and growth mindset has also been related to implicit theories of intelligence and even terms such as self-efficacy. The conceptual framework, reciprocal interactions, was proposed by Bandura (1986) to explain the dynamic interactions between environmental inputs (e.g., instruction), personal processes (e.g., social comparisons), and behavioral influences (e.g., effort). For example, the iterative process between perceived progress, self-efficacy, and goal pursuit is critical for student motivation and learning (Schunk and DiBenedetto, 2020). Similarly, since online and asynchronous instruction do not function in the same fashion as do in-person contexts, students' autonomy to plan for learning requires increased level of self-regulation. In other words, they need to set proper goals, select strategies, and metacognitively monitor their cognitive processes during learning (e.g., Miele and Scholer, 2017). Growth mindset messages have been shown to foster self-regulation in various contexts, such as substance use (Burnette et al., 2013, 2019a).

A long-term tele-education has adversely impacted traditional higher education and is likely to pose long-term impacts beyond the pandemic. Various instructional platforms ultimately led to a new teaching model that combined online teaching and autonomous learning (Canning et al., 2019; Sharma and Bhaskar, 2020). A recent study showed that the growth mindset could contribute to college students' learning engagement through the roles of perceived COVID-19 event strength (i.e., one's perception of external events) and perceived stress (i.e., one's feeling of internal pressure) during the COVID-19 pandemic. These factors have been suggested to promote sustained learning and positive emotion toward learning (Zhao et al., 2021).

The objective of this study is to answer the following three research questions:

1. What is currently known about the benefits and limitations of the growth mindset intervention in higher education?
2. What is the strength of the evidence in support of these findings?
3. What are the implications of these studies for instructional practices?

In addition to reviewing substantive findings regarding the growth mindset intervention, this review also aims to advance the understanding of relevant theories and practices and propose a practical framework for intervention implementation.

METHODS

This project adheres to the QUOROM statement (Moher et al., 1999) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for conducting systematic reviews (Moher et al., 2009, 2015).

Literature Search

We completed a search in four major electronic databases (APA PsycInfo, Web of Science, Scopus, and Pubmed) for articles up through January 2022 (i.e., no date restrictions) related to a combination of search terms relating to growth mindset, implicit theories of intelligence, population age (college and university students), intervention (e.g., educational intervention), and the type of study. All articles were filtered for article type (peer-reviewed), language of study (English), and publication (non-book chapters). Database specific filters were also applied if available. **Table 1** shows our specific search terms with article results by database.

TABLE 1 | Search terms used in article search across four databases.

Database	Field	Boolean search terms	Article results
APA PsycInfo	Abstract	(University or college or higher education) and (growth mindset or implicit theories of intelligence or self regul*) and intervention	277
NCBI PubMed	Abstract/Title *filtered by age 19–24	[(growth AND mindset) OR implicit theor* OR (self AND regulat*) AND [University OR college OR (higher AND education)] AND intervention [Title/Abstract]]	496
Scopus	Abstract	ABS (university OR college OR higher AND education) AND (growth AND mindset OR implicit AND theories AND of AND intelligence OR self-reg?) AND intervention	221
Web of science	Abstract	AB = [(university OR college OR higher education) AND (growth mindset OR implicit theories of intelligence OR self-reg*) AND intervention]	526

Inclusion and Exclusion Criteria

These database searches initially led to 1,520 relevant abstracts, and after removing 280 duplicates, 1,240 abstracts remained. For the remaining 1,240 abstracts, the lead researchers applied the eligibility criteria to identify relevant studies. Inclusion criteria included studies that (a) used empirical designs; (b) appeared in peer-reviewed journals; (c) were available in the English language; (d) involved growth mindset as a primary or secondary variable; (e) set within a higher education/college/university context and (f) included an intervention for growth mindset. The intervention or training should have been explicitly developed in line with the incremental theory of intelligence (Dweck and Leggett, 1988). Excluded articles included unpublished studies, gray literature such as business reports, conference proceedings, editorial comments, announcements, review articles (including previous systematic reviews), and single-case studies.

TABLE 2 | Overview of the selected studies.

References	Sample	Delivery	Intervention	Duration	Outcome measures
Brez et al. (2020)	Undergraduate students enrolled in gateway math and psychology courses across three academic terms (Mindset $n = 1,314$)	Randomly assigned (online) to either control or experimental group	Participants were randomly assigned to a fixed or growth mindset group to read an article about how the brain can/cannot grow stronger through effort and how difficult subjects such as math can/cannot be mastered and that anyone can learn math (or other subjects)	One-time	Course grade, term GPA, and term credit hours earned
Broda et al. (2018)	First-year incoming undergraduate students (Mindset $n = 2,135$)	Randomly assigned (online) to either control or experimental group	Participants in the mindset intervention group read a short scientific article on brain plasticity, indicating that intelligence is not fixed and can be improved with effort. After reading the article, students are asked several reflective questions in which they identify moments in life when they may have adopted a growth mindset	One-time	Grade point average (GPA), course credits attempted, course credits completed, full-time enrollment, cumulative GPA
Burnette et al. (2019b)	Undergraduate students enrolled in introductory computer science courses (Mindset $n = 245$)	Randomly assigned to either control or experimental group	Participants in the mindset intervention group read a short scientific article about brain plasticity, or the idea that the brain, similar to other muscles, can grow. Afterwards, participants were asked several reflective questions in which they are encouraged to identify moments in their own lives when they may have or have not adopted a growth mindset	Multiple sessions across a semester	High school GPA, ACT/SAT scores, Pell grant eligibility, and first-generation status
Cheng et al. (2021)	Graduate students (Mindset $n = 11$)	Randomly assigned to either control or experimental group	A set of infographics was developed with different topics for each week (i.e., narratives and visual images)	Weekly, over 6 weeks	Implicit theories of intelligence scale, written reflections
Daniels et al. (2020)	Undergraduate pre-service teachers (Mindset $n = 99$)	Randomly assigned to beliefs-only, approaches-only, combined beliefs and approaches, or control condition	Participants read a scientific article that contained accurate content about mindsets and emphasized teachers' capabilities to enhance student motivation and growth mindset	Multiple sessions across different terms	A set of post-intervention questionnaires (e.g., teachers' personal responsibility for student motivation)
Derr and Morrow (2020)	Undergraduate students (Mindset $n = 30$)	Randomly assigned to either one of the learning tasks that were designed to promote a growth mindset of personality (personality condition) or a matching exercise designed to promote a growth mindset of athleticism (athleticism condition) or control condition	Participants read an article designed to enhance individuals' endorsement of growth-oriented statements about personality	One-time	Defender self-efficacy, moral disengagement, and perceived defender behavior

(Continued)

TABLE 2 | Continued

References	Sample	Delivery	Intervention	Duration	Outcome measures
Fink et al. (2018)	Undergraduate students enrolled in general chemistry (Mindset $n = 275$)	Pseudo-randomly to either control or experimental group	Participants read a related short article online and completed a comprehension quiz, wrote a refection how the intervention influences their perception and behavior	3 1-h lectures per week during the first semester	Final-exam score, written responses to the phase 2 and 3 reflection prompts
Frey et al. (2018)	First-year undergraduate students enrolled in general chemistry (Mindset $n = 278$)	Randomly assigned to either control or experimental group	Students self-administered three doses of the intervention as part of their online homework	3 1-h lectures per week during the first semester	Final-exam score
Glerum et al. (2018)	Students enrolled in a vocational program (Mindset $n = 22$)	Randomly assigned to either control or experimental group	Watched three related short video clips and two post-videos short writing exercises	Multiple sessions over 10 weeks	Math test performance, implicit theories of intelligence scale
Goldstein et al. (2021)	Predominantly first-year undergraduate students in aerospace engineering, civil & environmental, industrial & systems engineering, and mechanical science and engineering ($n =$ 296)	Within-subject design	The workshop modules were concurrent with the courses and mirroring what was covered in each course. The workshop contains seven diverse topics designed to improve students' spatial visualization skills. For each topic, students were required to complete a set of online exercises.	A total of 3.5-h of a workshop that trained students in visual-spatial thinking over 7 weeks	Growth mindset for spatial intelligence, Purdue Spatial Visualization Tests
Hacisalihoglu et al. (2020)	First-year undergraduate students enrolled in the college of science and technology's Scientist Life Skills course ($n =$ 79)	Within-subject design	The course included videos and professional workshops on the concepts of growth mindset, grit, and critical thinking	Participants attended 2 weekly classes that included case studies, essays, and a final project (150 min in total)	Online mindset questionnaire, grit questionnaire, critical thinking assessment, and academic ranking
Lewis et al. (2020)	Community college registered nursing students ($n = 35$)	Within-subject design	A presentation on neuroplasticity, a brief video of an expert, discussion with peers, learning strategies that students could adopt to cultivate a growth mindset	An one-hour educational session	Williams Inventory of Learning Strategies (WILS) tool, including mindset assessment
McCabe et al. (2020)	First-year students enrolled in one of the required courses (Mindset $n = 119$)	Randomly assigned to either control or experimental group	Online academic talks related to growth mindset and infographic materials over a course	Multiple sessions over a semester	Mindset assessment, educational enjoyment, academic importance assessment, GPAs, retention
McPartlan et al. (2020)	Predominantly first-year undergraduate students enrolled in biological sciences (Mindset $n = 274$)	Randomly assigned to control, social belonging, combined, or growth mindset group	Read materials related growth mindset, Written reflections	One-time	Implicit theories of intelligence scale, written reflections, grades, single-item belonging uncertainty assessment
Miller and Srougi (2021)	Third and fourth year undergraduate students enrolled in a one semester biochemistry course (Mindset n = 87)	Cohorts were assigned to either control or experimental group	A set of metacognitive course activities, including self-reflection exercises, concept mapping, growth minded messaging, exam wrappers, and instructor talk that tends to foster a growth mindset	Over a semester	Biochemistry diagnostic assessment, online homework and quizzes, written reflections, final exam grade

(Continued)

TABLE 2 | Continued

References	Sample	Delivery	Intervention	Duration	Outcome measures
Mills and Mills (2018)	Undergraduate students enrolled in remedial math classes (Mindset $n = 98$)	Randomly assigned to either control or experimental group	Lessons taught the difference between growth and fixed mindsets. Lessons aimed to cultivate growth mindset, share stories of successful people. Participants were then asked to share stories of people that they knew who had persevered through adversity	4 weekly sessions (about 30 min each) over	Course grade, retention during the following semester, mindset assessment
Parada and Verlhiac (2021)	First-year undergraduate students enrolled in mandatory psychology course (Mindset $n = 125$)	Randomly assigned to control, original growth mindset, or revised growth mindset group	Participants read a scientific article describing intelligence and emphasizing its malleability and potential to grow through effort.	One-time	A set of questionnaires (e.g., achievement goal questionnaire, perceived stress, coping strategy), two-item mindset assessment
Samuel and Warner (2019)	First-year community college students enrolled in a two-semester developmental statistics course (Mindset $n = 17$)	Randomly assigned to either control or experimental group	Participants received a combination of mindfulness and growth mindset intervention (e.g., deep breathing session) and recited growth mindset messages	Multiple sessions over two semesters	A set of questionnaires and surveys (e.g., math anxiety and self-efficacy surveys), a subgroup of participants joined a focus group interview
Saraff et al. (2020)	First Year college students (Mindset $n = 150$)	Quasi-experimental non-randomization	Participants in one of the treatment groups (i.e., treatment 2 & 3) received mindfulness-based approach in developing the positive self-concept, self-esteem and growth mindset. In addition to the control group, treatment group 1 only discussed strategies of mindfulness. Treatment group 2 received meditation exercises along with mindfulness strategies	12 sessions of discussions and exercises based on meditation about 1-h	A set of scales (e.g., Self-concept Short Scale), implicit theories of intelligence scale
Torsney et al. (2021)	College and university students ($n = 116$)	Randomly assigned (online) to either control or experimental group	Participants were instructed to complete a packet of surveys at pretest and then engage in a series of activities, including reading a refutation text about the malleability of a student's intelligence	One-time (about 30 min)	Mindset scales, anticipated GPA for the semester, and open-ended questions asking their perception of intelligence

Additionally, other documents such as dissertations, case studies, book chapters, conference proceedings, reviews, or meta-analyses whose main independent variable was grit (Duckworth et al., 2007) or other closely relevant factors, were excluded from the article list if there was no mindset outcome.

Study Selection

The included titles and abstracts from our initial search were reviewed by both authors. Each reviewer blindly and independently reviewed each article's title and abstract and made a decision to exclude or include based upon the eligibility criteria. Once all reviews were complete, the authors un-blinded the independent reviews and resolved all conflicts through consensus. This reduced the list to 20 articles. See **Figure 1** for the PRISMA flow diagram (Moher et al., 2009).

Reporting Criteria

Once the final 20 articles were selected based on the inclusion and exclusion criteria, the two authors independently and methodically extracted data from each study and reconciled the findings by consensus. Specifically, we extracted data related to (a) sample, (b) delivery, (c) intervention, (d) duration, and (e) outcome measures (**Table 2**).

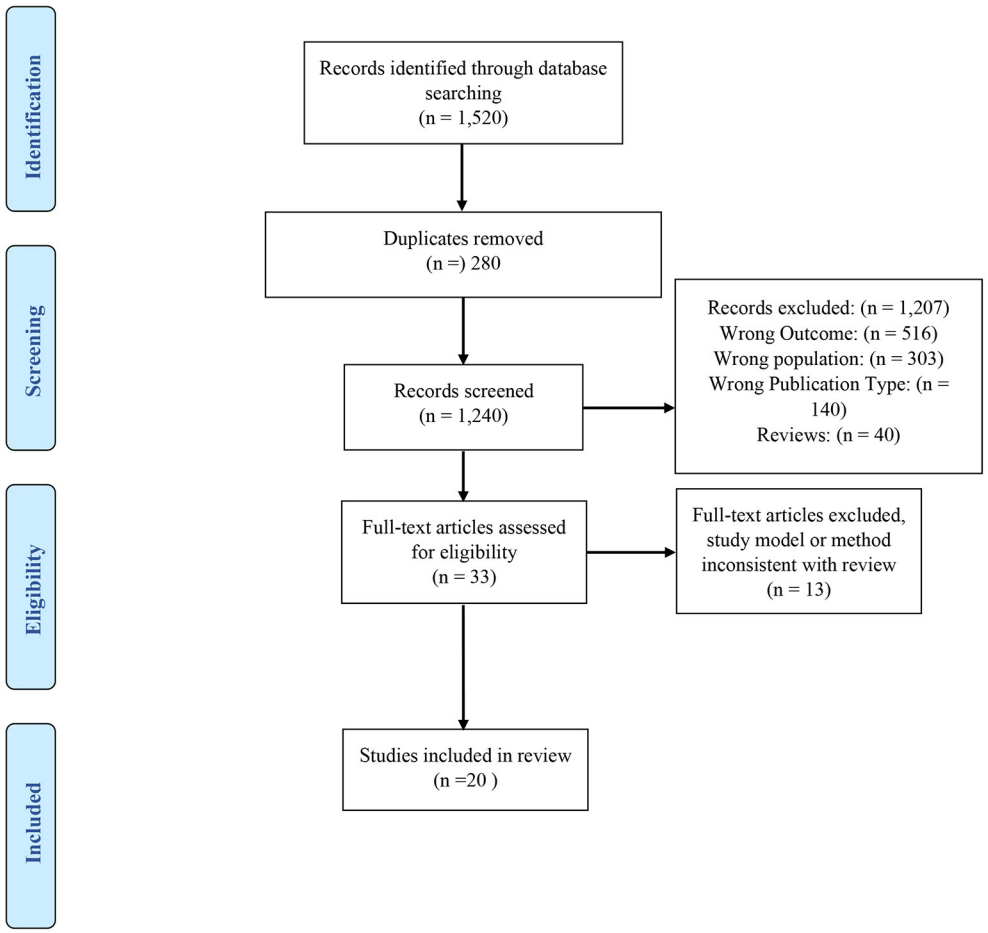

FIGURE 1 | PRISMA flow diagram of results and publication selection.

Assessment of Rigor

We also used the previously validated Checklist to Enhance Methodological Quality in Intervention Programs (Chacón-Moscoso et al., 2016) to better understand the methodological rigor of each study. This tool examines 12 characteristics of study quality, including inclusion and exclusion criteria for the units, experimental design, attrition, attrition between groups, exclusions after randomization, follow-up period, occasions of measurement, measures in pre-test appear in post-test, standardized dependent variables, control techniques, construct definition of outcome, and statistical methods for imputing missing data (see **Table 3**). In cases where the criteria were not discussed or assessed, we left the study "N/A" in the table. The two authors independently reviewed each included article using the assessment tool. Upon completion, they compared their results, and all conflicts were resolved by consensus.

RESULTS

The search yielded 1,240 publications, of which 20 articles finally met the inclusion criteria. All included studies were published within the last 5 years (2018–2021).

Study Participants

Eight studies examined the effects of growth mindset interventions on first-year undergraduate students enrolled in introductory courses (Frey et al., 2018; Samuel and Warner, 2019; Hacisalihoglu et al., 2020; McCabe et al., 2020; McPartlan et al., 2020; Saraff et al., 2020; Goldstein et al., 2021; Parada and Verlhiac, 2021). One study used graduate student sample (Cheng et al., 2021). One study used undergraduate students enrolled in remedial math course (Mills and Mills, 2018). One study used registered nurses (Lewis et al., 2020). One study used undergraduate students enrolled in a vocational program (Glerum et al., 2018). A portion of studies reported specific sample characteristics (e.g., different racial minorities, various socioeconomic statuses, and first-generation students). Finally, one study used undergraduate pre-service teachers (Daniels et al., 2020). A total of 5, 805 participants received a growth mindset intervention or an intervention that intends to cultivate a growth mindset (i.e., Saraff et al., 2020).

Content Areas

Eleven out of the twenty studies assessed the effectiveness of growth mindset interventions within STEM (e.g., math,

TABLE 3 | Methodological quality 12-item checklist.

References	Inclusion and exclusion criteria for the units provided	Methodology or design	Attrition	Attrition between groups	Exclusions after randomization	Follow-up period	Occasions of measurement for each variable	Measures in pre-test appear in post-test	Standardized dependent variables	Control techniques	Construct definition of outcome	Statistical methods for imputing missing data
Brez et al. (2020)	Yes	Experimental-Randomized	Yes	No	No	Yes	Pre- and post-intervention	All of them	Standardized questionnaires or self-reports	Masking (beneficiaries)	Replicable by reader in own setting	No
Broda et al. (2018)	Yes	Experimental-Randomized	Yes	Yes	Yes	Yes	Post-intervention only	N/A	Standardized questionnaires or self-reports	Masking (beneficiaries)	Replicable by reader in own setting	Yes
Burnette et al. (2020b)	Yes	Experimental-Randomized	Yes	Yes	Yes	Yes	Pre- and post-intervention	All of them	Standardized questionnaires or self-reports	Double-masking	Replicable by reader in own setting	Yes
Cheng et al. (2021)	Yes	Experimental-Randomized	Yes	Yes	Yes	Yes	Pre- and post-intervention	All of them	Standardized questionnaires or self-reports	Masking (beneficiaries)	Replicable by reader in own setting	N/A
Daniels et al. (2020)	Yes	Experimental-Randomized	Yes	Yes	Yes	Yes	Pre- and post-intervention	All of them	Standardized questionnaires or self-reports	Masking (beneficiaries)	Vague definition	N/A
Derr and Morrow (2020)	Yes	Experimental-Randomized	Yes	Yes	Yes	N/A	Pre- and post-intervention	All of them	Standardized questionnaires or self-reports	Masking (beneficiaries)	Replicable by reader in own setting	Yes
Fink et al. (2018)	Yes	Experimental-Randomized	Yes	Yes	Yes	Yes	Post-intervention only	N/A	Standardized questionnaires or self-reports	Masking (beneficiaries)	Replicable by reader in own setting	No
Frey et al. (2018)	Yes	Experimental-Randomized	Yes	Yes	Yes	Yes	Post-intervention only	N/A	Standardized questionnaires or self-reports	Masking (beneficiaries)	Vague definition	No
Glerum et al. (2018)	Yes	Experimental-Randomized	Yes	Yes	N/A	Yes	Pre- and post-intervention	All of them	Without (self-reports and *post-hoc* records)	Masking (beneficiaries)	Vague definition	N/A
Goldstein et al. (2021)	Yes	Pre-Experimental/Others	Yes	N/A	N/A	Yes	Pre- and post-intervention	All of them	Without (self-reports and *post-hoc* records)	Other (need to specify)	Replicable by reader in own setting	N/A
Hacisalihoglu et al. (2020)	Yes	Quasi-Experimental	N/A	N/A	N/A	Yes	Pre- and post-intervention	All of them	Without (self-reports and *post-hoc* records)	Other (need to specify)	Replicable by reader in own setting	N/A
Lewis et al. (2020)	Yes	Quasi-Experimental	N/A	N/A	N/A	Yes	Pre- and post-intervention	All of them	Without (self-reports and *post-hoc* records)	Other (need to specify)	Replicable by reader in own setting	N/A
McCabe et al. (2020)	Yes	Experimental-Randomized	Yes	Yes	Yes	Yes	Post-intervention only	All of them	Without (self-reports and *post-hoc* records)	Masking (beneficiaries)	Replicable by reader in own setting	N/A
McPartlan et al. (2020)	Yes	Experimental-Randomized	No	No	No	Yes	Pre- and post-intervention	All of them	Without (self-reports and *post-hoc* records)	Masking (beneficiaries)	Replicable by reader in own setting	No
Miller and Srougi (2021)	Yes	Quasi-Experimental	No	No	No	Yes	Pre- and post-intervention	All of them	Without (self-reports and *post-hoc* records)	Masking (beneficiaries)	Replicable by reader in own setting	N/A
Mills and Mills (2018)	Yes	Experimental-Randomized	Yes	Yes	Yes	Yes	Pre- and post-intervention	All of them	Standardized questionnaires or self-reports	Masking (beneficiaries)	Replicable by reader in own setting	N/A
Parada and Verlhiac (2021)	Yes	Experimental-Randomized	Yes	Yes	Yes	Yes	Pre- and post-intervention	All of them	Without (self-reports and *post-hoc* records)	Double-masking	Replicable by reader in own setting	N/A
Samuel and Warner (2019)	Yes	Experimental-Randomized	Yes	Yes	N/A	Yes	Pre- and post-intervention	Some	Without (self-reports and *post-hoc* records)	Masking (beneficiaries)	Replicable by reader in own setting	N/A
Saraff et al. (2020)	Yes	Quasi-Experimental	No	No	No	Yes	Pre- and post-intervention	All of them	Without (self-reports and *post-hoc* records)	Masking (beneficiaries)	Vague definition	N/A
Torsney et al. (2021)	Yes	Experimental-Randomized	Yes	Yes	N/A	Yes	Pre- and post-intervention	All of them	Without (self-reports and *post-hoc* records)	Masking (beneficiaries)	Replicable by reader in own setting	N/A

statistics, psychology, computer science, engineering, biology, biochemistry, and chemistry). Other studies did not specify its contexts in terms of content area. There is increasing interest today in how a brief mindset intervention may contribute to outcomes other than academic achievement (e.g., GPA). It is evident that researchers in different disciplines have started to recognize the value and the need of psychological interventions in addition to regular courses in higher education. Specifically, an increasing literature has examined the effectiveness of Wise interventions (WIs), which focuses on a single construct, often drawn from diverse psychological perspectives, and target specific psychological processes (O'Brien and Lomas, 2016; Walton and Wilson, 2018). WIs are generally brief and more focused, and thus can be easily incorporated into original curricula.

Research Methods and Data Analyses

As can be seen in **Table 1**, different studies used very different research designs and outcome measures. Thirteen studies used only quantitative methods, whereas seven studies used mixed methods, such as written reflection (e.g., Fink et al., 2018; Cheng et al., 2021). This variability makes it difficult to meta-analyze these results. For example, two of the selected studies examined factors that might indirectly influence individuals' levels of growth or fixed mindsets using a path analysis. We might, therefore, observe important discrepancies in the effect sizes reported while we adopt a more rigorous means to summarize these results (Moreau, 2020). It is also important to consider qualitative results pertaining to the use and effectiveness of a growth mindset intervention in higher education (e.g., Limeri et al., 2020), such as self-reported psychological wellbeing, social belonging, and perception of peers.

Materials and Delivery Methods

In general, most included studies used randomized controlled trial (RCT) design. Participants were randomly assigned to a growth mindset intervention or a matched control group. As mentioned before, one study used quasi-experimental non-randomization (Saraff et al., 2020) and three studies used within-subject design (i.e., no randomization). Most studies followed the guidelines reported in Yeager et al. (2016). Several studies modified the common intervention to meet their needs. For example, Derr and Morrow (2020) asked their participants to read a vignette of a peer student victimized by his or her peers, and then completed paper-and-pencil measures of defender self-efficacy, moral disengagement, and perceived defender behavior. The intervention has two versions that were identical with one exception; the control condition included an exercise designed to promote a growth mindset of athleticism while the experimental condition included an exercise designed to promote a trait growth mindset.

Another revision was reported in Torsney et al. (2021). Refutation texts were used as part of the growth mindset intervention. Refutation intends to introduce a misconception to students and help them identify scientifically inaccurate concepts and acquire evidence-based knowledge. Moreover, their findings suggested that refutation text along with other educational activities can change, at least momentarily, college students' implicit theories of intelligence. Ninety five percent of the included studies delivered the intervention materials through an online platform (e.g., learning management system).

A PRACTICAL FRAMEWORK FOR PRACTICING GROWTH MINDSET

Post-secondary students are increasingly transitioning to an internet-based method of teaching and learning. While the general public becomes anxious, panic, or even depressed about the social isolation, students in higher education experience more uncertainty and hopelessness about their future. The new reality has forced students to change plans and adjust to the current situation. Every individual might attend to or interpret these stressors differently making emotion regulation strategies an urgent need (see Tabibnia and Radecki, 2018 for a review). Learning in higher education is not solely determined by individuals' personal characteristics, but also to the extent that the teachers able to support or hinder learning and motivation (Jeno, 2015). In the time of self-isolation, educational institutions and their instructors may bear an important responsibility for helping young learners adjust to both physical and psychological changes.

There may be college- or department-wide services for helping students access additional resources to reduce the impact of the pandemic on financial needs. However, supports for students' mental health seem sparse (Lee, 2020). Tabibnia and Radecki (2018) provides very useful and empirically tested behavioral strategies that enhance psychological resilience in the face of negative emotions. For example, recognizing one's own emotions and expressing them explicitly to their close friends and family members could significantly reduce the detrimental effects of negative emotions and thoughts. Universities could frequently track the wellbeing needs of their students over the different stages of the COVID-19 pandemic and encourage their learners to seek ways to make the best out of the situation.

The second part of this study includes a proposal for a practical framework for instructors in higher education to revisit the idea of growth mindset based on the findings reported here and to manage different sub-abilities that have been shown to be highly associated with growth mindset. In fact, growth mindset has become more of a general term suggesting that human abilities can be developed through effort (Dweck, 2006; Yeager and Dweck, 2020). Developing a more nuanced view of growth mindset in light of the sub-abilities undergirding it is one way that growth mindset can become easier to implement in educational settings.

To educators, implementing growth mindset ideas in the curriculum can be dreadful and requires enormous energy and dedication. However, we propose that implementing growth mindset is too large of a goal. Instead, growth mindset can and should be considered as a multifaceted concept. By doing it, implementing growth mindset pedagogy becomes more manageable. In what follows, we identify three components of self-regulation, self-efficacy, and self-esteem, ones that have been frequently shown to be associated with growth mindset and are

FIGURE 2 | A practical framework for practicing growth mindset-related components & related references.

vital to its implementation in higher education (see **Figure 2**). Interested readers are encouraged to refer to these articles.

Boekaerts and Cascallar (2006) addressed some of the most critical questions concerning self-regulation, such as "What is self-regulated learning?," "What strategies do students need to direct their own learning?," "What environmental cues would trigger self-regulation strategies?," and "What can teachers do to help student to self-regulate their learning?." They provided very valuable and useful recommendations for instructional practices to promote self-regulation in young adults.

A significant number of previous findings have shown that self-esteem and/or self-efficacy are closely associated with growth mindset (e.g., Burnette et al., 2019b) or, at least, highly correlated with grade (e.g., Li and Bates, 2020). Self-efficacy is one's belief in their capacity to act to achieve desired outcomes (Bandura, 1997; Hope et al., 2013). Self-efficacy and self-esteem represent two different psychological variables and need to be managed differently. Generally, self-efficacy is more associated with motivational constructs than is self-esteem, whereas self-esteem is more associated with affective constructs (Chen et al., 2004; Jordan et al., 2018). Recent findings suggest that self-efficacy-focused curriculum is urgently needed when transitioning from traditional classrooms to other teaching and learning modalities (Talosa et al., 2021). By distilling growth mindset into these three core sub-abilities of self-regulation, self-efficacy, and self-esteem, educators can better focus their curricula and efforts on their desired outcomes (Zander et al., 2018).

Derr and Morrow (2020) suggest that participants who received the growth mindset intervention reported higher defender self-efficacy, which indirectly increase their likelihood of peer defending (i.e., prosocial behavior). While Li and Bates (2020) did not find any correlation between growth mindset and grade, they observed a significant correlation between college students' grades and self-efficacy. A systematic review of the effectiveness of growth mindset intervention (Cheng et al., 2021) summarizes several mindset interventions, materials, and other relevant psychological variables (i.e., self-esteem). Although the review did not limit to randomized controlled trial studies, it provides valuable information for educators in higher education to implement growth-mindset-induced activities in their own classrooms.

Recent electrophysiological findings have shown that individuals possessing higher level of growth mindset attend to errors more often than those in a control group and have higher post-error accuracy (e.g., Schroder et al., 2014; also see Ng, 2018 for a review). Similarly, growth mindset has been shown to predict self-regulatory practices and strategies in the face of failures and challenges (see Burnette et al., 2013 for a review). Therefore, it is important to include self-regulation in the current proposal. Self-regulation can be conceptualized as goal-related processes, including goal setting, goal operating, and goal monitoring (Carver and Scheier, 2008). Self-regulatory strategies have been shown to be crucial to the initial development of a skill and individual performance in natural settings (Zimmerman, 1998). Educators in higher education can design their curricula accordingly to provide timely support and guidance to the students.

DISCUSSION

This study presented a systematic review of growth mindset interventions among higher education students and a proposed framework to explore the sub-abilities of growth mindset. Using multiple databases and specified key word searches, the authors narrowed the entirety of growth mindset literature studies to 20 studies that met the inclusion criteria. Those articles were then examined to answer three research questions.

Our first research question considered the benefits and limitation of growth mindset intervention literature in higher education populations. Our synthesis showed that growth mindset intervention is a brief and easily administered intervention for diverse content areas in higher education. The growth mindset intervention was easily integrated into instructional materials. However, we have identified several limitations of these selected papers. First, many studies do not include follow-up periods to determine how well-changes brought about by the growth mindset intervention endure over time or transfer to other contexts outside of the intervention. Most of the studies use a pre-post design, but few studies examined student mindset at a follow-up time point, either in school or afterwards. This is a serious limitation in that the purpose of the intervention is to empower students and take control over their own learning, which extends beyond the classroom, especially considering changes due to the pandemic. Thus, it would be desirable to know whether mindset changes

remain after conclusion of the intervention. More research is needed to examine whether these interventional effects can be maintained and generalized to contexts outside of the instructional setting.

Our second research question examined the strength of the evidence of these findings. Our analysis discovered that many studies were lacking in statistical rigor. For example, almost 90% of the selected studies did not mention anything about the missing data. In other words, the authors did not report the presence of missing data during the data collection process and if they did, how did they address those missing data. Specifically, the validity of research inferences can be severely compromised due to improperly handling missing data (Lang and Little, 2016). In **Table 3**, most studies were labeled n/a for the column of missing data imputation. Since we did not even know whether these studies had missing responses in their data, we decided to label them under the not applicable category. We recommend that future studies clearly state the details about the missing data.

Our final research question considered the implications of these findings for instructional practice and implementation in higher education and reported thematic connections among the studies. Our findings suggest that growth mindset interventions have been used in science, technology, engineering, and math, with analyses ranging from quantitative to mixed methods to qualitative. Higher education interventions also include a wide variety of participants, including students representing education of undergraduates, graduates, and medicine. COVID-19 significantly disrupted in-person and face-to-face interactions. Consequently, virtual interventions have become increasingly common, and it is unclear how more or less effective virtual interventions are, in comparison to face-to-face interventions. It is still uncertain the extent of the effectiveness of virtual mindset interventions in the academic trajectory of students, after the intervention is complete. Not only has the way of instruction delivery changed, but also how people connect and communicate with one another. In this time of uncertainty, growth mindset, or broadly speaking, psychological resilience, is a critical priority.

In addition, growth mindset is not a unitary concept, and is associated with multiple sub-abilities, such as self-regulation and self-awareness (Mrazek et al., 2018). How might these abilities help us remain socially connected? Research has begun to address students' attitudes toward face-to-face vs. online instruction (e.g., Cole, 2016). In face-to-face learning, students could communicate with their instructors effectively through body language and gestures, whereas it seems more difficult with online instruction. Thus, students often experience frustration in the process of transitioning to online learning and continue to experience frustration afterwards (Cataudella et al., 2021). As a result, reflecting upon oneself (e.g., self-reappraisal strategy to reframe an event and respond differently) and exerting aforementioned abilities are essential in protecting faculty, staff, and students from chronic mental illnesses.

With signs that the spread of the pandemic is coming under control, it is time to prepare higher education systems for the new normal after the pandemic and its variants. Major changes and precautions might be in place immediately after campuses reopening. Therefore, educational institutions may need to provide more than one alternative for their students to learn, so that they would consider it as an opportunity to choose the most suitable and comfortable way to learn for them.

One of the benefits for having a growth mindset is that growth minded individuals tend to view mistakes as opportunities to learn and improve. Cognitive neuroscience has shown that growth minded individuals display higher post-error accuracy and reduced neural activity of emotional distress to mistakes made during the task (Moser et al., 2011). In the face of psychological and physical challenges, both educators and students need to re-examine the concept of growth mindset and cultivate their sub-abilities. If being growth minded is the ultimate goal, then developing these sub-abilities, or skills, is our immediate goal, as learning is a marathon, not a sprint.

As mentioned earlier, adaptive coping strategies are important and learnable. As psychological and neuroscientific research on growth mindset continues to accelerate, higher educational institutions play a key role in helping their students combat distress and recover from the current crisis. The new normal implies that campus life will never be the same for all of us. Under this circumstance, factors such as cultural sensitivity, socioeconomic status, gender equality, and financial downturn need to be more deeply and carefully considered.

Importantly, mental and physical illness can become chronic, resulting from high stress levels. Engaging in active coping strategies in response to the crisis may help to manage current and future stressors, which in turn encourages healthy mental and physical functioning. Simply put, in difficult times like this, educational institutions should bear more responsibility than ever to provide additional assistance to help their students avoid unhealthy choices (e.g., substance abuse). In this regard, growth mindset, or resilience in general, becomes more indispensable than ever. Institutional services and support should be implemented to help those students who have lost their usual routines and are stuck in chronic passivity to overcome barriers and succeed.

CONCLUSION

As universities, colleges, and students plan and prepare for an unknown future, how might these educational institutions help students along the way to a successful career? A more positive and malleable way of interpreting our surroundings matters more than ever. While some students might have better self-regulatory skills, others do not. Therefore, higher education institutions can help their students identify additional resources, try new strategies, and seek input from others to promote resilience and their psychological needs over various stages of the pandemic. Likewise, students may use their time while learning remotely to develop the sub-abilities associated with growth mindset, so that they can maintain productivity and contribute to their institutions. Taken together, this paper hopes to summarize recent empirical findings about growth mindset interventions and conclude with practical considerations for application of the proposed framework to implement growth-mindset-related practices in higher education.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

Y-RK conceived and designed the analysis. CS performed the analysis. Y-RK and CS wrote the manuscript. Both authors contributed to the article and approved the submitted version.

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