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## EDITED BY

María Esther Rincon,  
Universidad CEU San Pablo, Spain

## REVIEWED BY

Metin Kus,  
Hittite University, Türkiye  
Cândida Filgueira Arias,  
CEU San Pablo University, Spain

## \*CORRESPONDENCE

Liia Ots  
✉ liia.ots@tlu.ee

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# School-based interventions for problematic digital technology use: a systematic review

Liia Ots\*, Grete Arro, Kati Aus and Piret Oppi

School of Educational Sciences, Tallinn University, Tallinn, Estonia

**Background:** Problematic or addictive use of digital technologies, such as smartphones, gaming, and social media, is increasingly prevalent among adolescents and associated with negative academic, psychological, health, and social consequences. Schools represent a fitting setting for delivering preventive interventions. **Objectives:** This systematic review aimed to (1) identify school-based interventions delivered by school personnel, (2) evaluate their effectiveness, and (3) explore factors that underpin successful outcomes.

**Methods:** A systematic search of EBSCOhost and Web of Science databases identified five eligible controlled trials (three RCTs, two quasi-experiments; ~10,000 participants). Risk of bias was assessed using the Cochrane RoB 2 tool. Due to heterogeneity in outcomes and intervention types, a narrative synthesis approach was employed.

**Results:** Results showed that teacher-delivered universal curricula produced modest improvements in awareness and smartphone use patterns, but inconsistent reductions in addiction measures. Selective, skills-based interventions—including peer education, solution-focused counselling, and play-based substitution—yielded greater reductions in problematic use and additional benefits in health behaviors, social skills, and academic self-perception. Interventions that incorporated goal setting, behavioral substitution, and peer engagement were found to be most effective. However, the evidence is constrained by heterogeneous measures, short follow-up, and predominantly self-reported outcomes.

**Conclusion:** School-based programs can reduce problematic digital use, particularly when they are interactive, psychosocially grounded, and tailored to developmental needs. Future research should prioritize longer-term follow-ups, standardized outcome measures, and scalable implementation models.

## KEYWORDS

adolescents, digital well-being, prevention, problematic digital technology use, school-based intervention, systematic review

## 1 Introduction

Digital technologies are deeply embedded in the everyday lives of children and adolescents worldwide. The wide spread of smartphones and social networking platforms has transformed how young people learn, interact, and spend their time, bringing clear benefits for access to information and social connectedness, but also raising concerns about attention-related problems, academic achievement, well-being, and the emergence of problematic or addictive patterns of use (Lopez-Fernandez, 2021; OECD, 2024). Large international surveillance efforts—including EU Kids Online, Healthy Behavior in School-aged Children (HBSC), Program for International Student Assessment (PISA)—consistently indicate a rise in daily

online engagement among adolescents (Boniel-Nissim et al., 2024; Smahel et al., 2020; OECD, 2024). This upward trajectory was amplified by the COVID-19 pandemic, establishing excessive usage patterns that have persisted in the post-pandemic period (Marciano et al., 2022; Boniel-Nissim et al., 2024). However, interpreting these trends and their implications for prevention and intervention requires conceptual clarity, as the literature uses “digital addiction” and related terms in varied ways and with different measurement approaches (Kuss and Lopez-Fernandez, 2016). Establishing this conceptual clarity is essential for identifying the precise threshold where high-intensity digital engagement transitions into the maladaptive patterns that interfere with an adolescent’s daily functioning (Przybylski and Weinstein, 2017).

The concept of “digital addiction” (often operationalized as problematic internet, smartphone, gaming, or social-media use) has evolved over nearly three decades (Young, 1998; World Health Organization, 2025). While only *gaming disorder* is formally included in ICD-11 (World Health Organization, 2025), research now addresses multiple related behaviors like problematic smartphone use, excessive social media engagement, and online gaming (Kuss and Lopez-Fernandez, 2016; Nawaz, 2023). Although prevalence estimates vary by measure and context, international surveys suggest that between 10 and 20% of adolescents report symptoms related to excessive use of digital content (Smahel et al., 2020; OECD, 2024). The scale of these reported symptoms highlights the necessity of identifying the specific nature of a student’s digital challenges to ensure that the response is accurately tailored to their support needs.

This becomes more relevant, since from a prevention perspective, frequent digital engagement is not synonymous with clinical disorder. It is crucial to distinguish between clinical addiction, which requires professional intervention, and “problematic use,” which is often addressable at the school level (Przybylski and Weinstein, 2017). “Problematic use” refers to maladaptive patterns of digital engagement that interfere with daily functioning (e.g., sleep, schoolwork, or offline relationships) but do not meet diagnostic thresholds (Young, 1998; Przybylski and Weinstein, 2017). Common warning signs include progressively longer periods spent online, impulsivity, and difficulties limiting activity (Throuvala et al., 2021), often resulting in stress or irritability when access is restricted (Do and Kim, 2024). By contrast, clinical-level disorders (e.g., gaming disorder) are characterized by a persistent and severe pattern that includes impaired control, increasing priority given to the activity over other life domains, and continuation despite negative consequences, all features central to ICD-11 gaming disorder (World Health Organization, 2025).

International surveillance data provide a complementary perspective by estimating how common these impairment-linked patterns are among adolescents. For example, the EU Kids Online 2020 survey found that up to 21% of European children aged 9–16 regularly neglected family, friends, or schoolwork due to the time spent online (Smahel et al., 2020). Beyond how common problematic use is, recent surveys also shed light on its intensity and associated risks. HBSC 2021/22 (Boniel-Nissim et al., 2024) provides a descriptive picture of intensity of social media use among adolescents. It reports that 44% of adolescents fall into “active” and 32% into “intense” patterns, while 11% having six or more symptoms of problematic use. These usage patterns are associated with significant health risks. Excessive social media use is linked to body dissatisfaction and peer comparison, especially among girls (Holland and Tiggemann, 2016). These effects

appear to reflect not only the amount of time spent online but also the types of content consumed.

These patterns have direct implications for schools, where digital engagement increasingly intersects with learning and classroom functioning. In PISA 2022 (OECD, 2024) approximately one in three students reported being distracted in most or all mathematics lessons by their own digital device use, while one in four were distracted by the device use of peers. A connection between time spent online and academic performance was found: students who spent more than 6 h per day online achieved the lowest mathematics scores, whereas moderate users performed better and reported stronger feelings of belonging at school.

At the same time, and in contrast to these risks, moderate, purposeful use of digital tools can support learning and social ties, suggesting that a balanced approach—neither prohibition nor unfettered access—is warranted (OECD, 2024; Przybylski and Weinstein, 2017; Rozgonjuk et al., 2021). This tension between potential harms and meaningful benefits makes prevention especially challenging: interventions need to reduce problematic use without undermining opportunities for learning and connection.

This tension between risks and benefits further highlights the need for prevention approaches that are nuanced, developmentally informed, and context-sensitive. Prevention science highlights that effective school-based interventions operate across multiple domains, including individual skills, social influences, and the broader educational environment (European Monitoring Centre for Drugs and Drug Addiction, 2019). In European prevention research, this multi-dimensional perspective is reflected in the European Prevention Curriculum (EUPC), developed by the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) to support evidence-based prevention practice across settings, including schools. Although originally developed for substance use prevention, the EUPC has broader applicability to other risk behaviors and offers a structured approach for considering intervention content, delivery, and implementation within real-world educational systems (European Monitoring Centre for Drugs and Drug Addiction, 2019). In this review, the EUPC framework is used as an organizing lens to synthesize school-based interventions for problematic digital technology use, with particular attention to delivery by existing school personnel and relevance for educational practice. Central to this framework is the etiology model, which posits that problematic digital use is the result of bi-directional interactions between individual personal characteristics (genetic predisposition, temperament, self-regulation) and the adolescent’s micro-level (family, peers, school) and macro-level (community, societal attitudes, policy) environments.

Within the framework of EUPC, a range of risk factors increases the likelihood of problematic use (European Monitoring Centre for Drugs and Drug Addiction, 2019). These include difficulties with emotion regulation and poor self-control (Wichstrøm et al., 2019; Throuvala et al., 2021). Another prominent factor is escapism—the use of online environments to avoid negative emotions or stressful life situations (Hamad et al., 2023). While adaptively useful for short-term recovery, constant escapism creates a negative cycle where avoidance prevents the development of effective coping strategies (Do and Kim, 2024; Throuvala et al., 2021). Social risk factors also play a critical role; children with weak face-to-face social skills may prefer online interactions, which can increase dependence and limit opportunities to develop offline competencies (Kuss and Lopez-Fernandez, 2016; Wichstrøm et al., 2019). Furthermore, the strong need to belong

during adolescence acts as a vulnerability factor (Ostendorf et al., 2020), as do negative parenting practices such as overprotection or parental device overuse (Faltýnková et al., 2020).

Conversely, protective factors buffer the impact of these risks. At the individual level, stabilizing attentional control, persistence, life satisfaction, and self-confidence is associated with reduced vulnerability (Do and Kim, 2024; Ostendorf et al., 2020). Resilience cultivated offline appears to generalize to online contexts, as adolescents who cope effectively with stress show a lesser inclination to retreat into digital environments (Sage et al., 2021). Within the family micro-context, parental warmth, interest, and supervision are associated with lower risk (Faltýnková et al., 2020).

However, many of these protective capacities do not develop in isolation and require supportive social contexts to be consistently reinforced. Protective factors are shaped not only within families but also through the structured routines, peer norms, and skill-building opportunities that schools can systematically provide (European Monitoring Centre for Drugs and Drug Addiction, 2019). That makes schools alongside the home, one of the most influential micro-level environments for children's development. Schools do represent a highly effective and cost-efficient setting for universal prevention, including the prevention of smartphone addiction (European Monitoring Centre for Drugs and Drug Addiction, 2019), offering a key opportunity to integrate mental health interventions within a wider system of care (Fazel et al., 2014).

Despite this theoretical and practical promise, existing reviews highlight the scarcity of high-quality prevention trials. Some reviews (e.g., Bağatarhan and Siyez, 2017; Vondráčková and Gabrhelík, 2016) primarily provided broad overviews of prevention approaches and conceptual developments in this field, while others focused on synthesizing evidence of intervention effectiveness (e.g., Throuvala et al., 2019; Romero Saletti et al., 2021; Xu et al., 2021). More recent reviews (Zhang et al., 2023; Theopilus et al., 2024) confirm the growth of research but still conclude that the evidence base remains fragmented and that school-based randomized controlled trials are often underrepresented. Against this background, our review focuses on contemporary, school-delivered prevention strategies implemented by existing school personnel, an area that remains underrepresented in prior syntheses. As a result, it remains unclear which school-based prevention approaches are scalable and can be delivered by existing school staff and are effective.

To address this uncertainty, the present review systematically synthesizes evidence from school-based trials with the following objectives:

- 1 To identify school-based interventions designed to address problematic digital technology use delivered by school personnel.
- 2 To evaluate the effectiveness of these interventions.
- 3 To explore the mechanisms and protective factors that underpin successful outcomes to inform future prevention strategies in educational contexts.

## 2 Methods

A systematic review following the PRISMA 2020 guidelines was conducted. The protocol was not registered.

### 2.1 Eligibility criteria

The review included only controlled trials (randomized or quasi-experimental) where the intervention was designed for and conducted within a general education school setting. An additional requirement was that the intervention had to be delivered by existing school-based personnel to ensure the findings were relevant and scalable to typical educational practice. The review's scope was strictly limited to controlled effectiveness research. Therefore, we excluded all studies without a control group. To ensure the findings were relevant to education systems, studies conducted in clinical settings or those implemented solely by outside-school experts were excluded. Finally, due to practical constraints related to translation and synthesis, we limited our inclusion to studies published in the English language.

### 2.2 Information sources and search

The systematic literature was conducted in *Web of Science* and *EBSCOhost*, searching the ERIC, MEDLINE, and APA PsycInfo databases. The filter for the date of publication was set between the 1st of January 2022 and the 1st of January 2025, during the search in EBSCOhost on the 27th of October 2024 and in Web of Science on the 4th of November 2024. The last search was done on the 12th of April 2025, and the publication date filter was set to 04.11.2024–12.04.2025. The search was conducted using the following search terms: “adolescence” OR “youth\*” OR “teen\*” OR “child\*” OR “preteen” OR “elementary school” OR “middle school” OR “high school” OR “primary education” OR “secondary education” OR “kindergarten” OR “grade 1” OR “grade 2” OR “grade 3” OR “grade 4” OR “grade 5” OR “grade 6” OR “grade 7” OR “grade 8” OR “grade 9” OR “grade 10” OR “grade 11” OR “grade 12” AND “problematic internet us\*” OR “compulsive internet us\*” OR “pathological internet us\*” OR “excessive computer us\*” OR “internet addict\*” OR “smartphone addict\*” OR “cellphone addict\*” OR “excessive mobile phone us\*” OR “problematic smartphone us\*” OR “problematic mobile phone us\*” OR “problematic online gaming” OR “internet gaming” OR “Online gaming” OR “gaming addict\*” OR “internet gaming addict\*” OR “internet gaming disorder” OR “gaming disorder” OR “problematic social media us\*” OR “problematic social networking us\*” OR “social network addict\*” OR “facebook addict\*” OR “instagram addict\*” OR “problematic social networking” AND “prevention” OR “prevent” OR “prevention program” OR “psychoeducation” OR “online program” OR “intervention” OR “action research” OR “curricula” OR “digital education” OR “intervention program” OR “experiment” OR “digital detox.”

### 2.3 Selection and data collection

The search process initially identified 1,112 records. After removal of duplicates, 769 unique records remained. Titles and abstracts were screened by one reviewer (L.O.), resulting in 19 articles for full-text assessment. We used a sensitivity-oriented approach at this stage: records were retained for full text if (1) the setting appeared to be a general-education school, (2) the design was controlled or this was unclear from the abstract, (3) delivery might have been by school personnel (or implementers were unspecified), (4) participants were school-aged, and/or (5) outcomes referenced problematic internet/smartphone use or closely related constructs. In other words, any ambiguity on a core eligibility criterion (e.g., who delivered the intervention, presence of a control group, exact age range, or whether the

program was school-embedded) triggered full-text assessment to minimize false exclusions.

Each of these full texts was independently reviewed by two researchers: P.O. assessed eight articles, G.A. seven articles, and K.A. four articles, in addition to L.O., who reviewed all 19. Following this process, 14 studies were excluded. The primary reason for exclusion was the absence of a control group. Additional reasons included delivery of the intervention exclusively by external professionals, the intervention being a mobile application, a focus on adult participants, or the primary outcomes being unrelated to digital use. The following data were extracted from the included studies: (1) names of author(s), (2) objectives, (3) methods used, (4) underlying theory, (5) overview of the intervention, (6) sample, (7) scales used, (8) effect size, and (9) country. The main characteristics are summarized in [Table 1](#).

## 2.4 Risk of bias

Risk of bias was assessed using the Cochrane RoB 2 tool. Across the five included trials (three RCTs and two quasi-experiments), risk of bias was judged as moderate to low overall, with some concerns arising mainly from allocation concealment and potential contamination in cluster-randomized designs. Each study was evaluated by two researchers. After performing the assessment individually, the researchers discussed the results, and a consensus was reached.

The five included trials varied considerably in their intervention models, outcome measures, and reporting practices. Validated addiction scales, behavioral proxies, and psychosocial outcomes were not consistently assessed across studies, and statistical information required for pooling was often incomplete. As a result, meta-analysis was not possible. Instead, we adopted a narrative synthesis approach, systematically organizing results by intervention type

(e.g., teacher-led curricula, peer-led education, counselling, play-based substitution), outcome domains (problematic use, behavioral skills, psychosocial health), and direction of effects. This approach enables the comparison of findings across heterogeneous designs, while highlighting common mechanisms and differences in effectiveness.

## 3 Results

### 3.1 Study selection

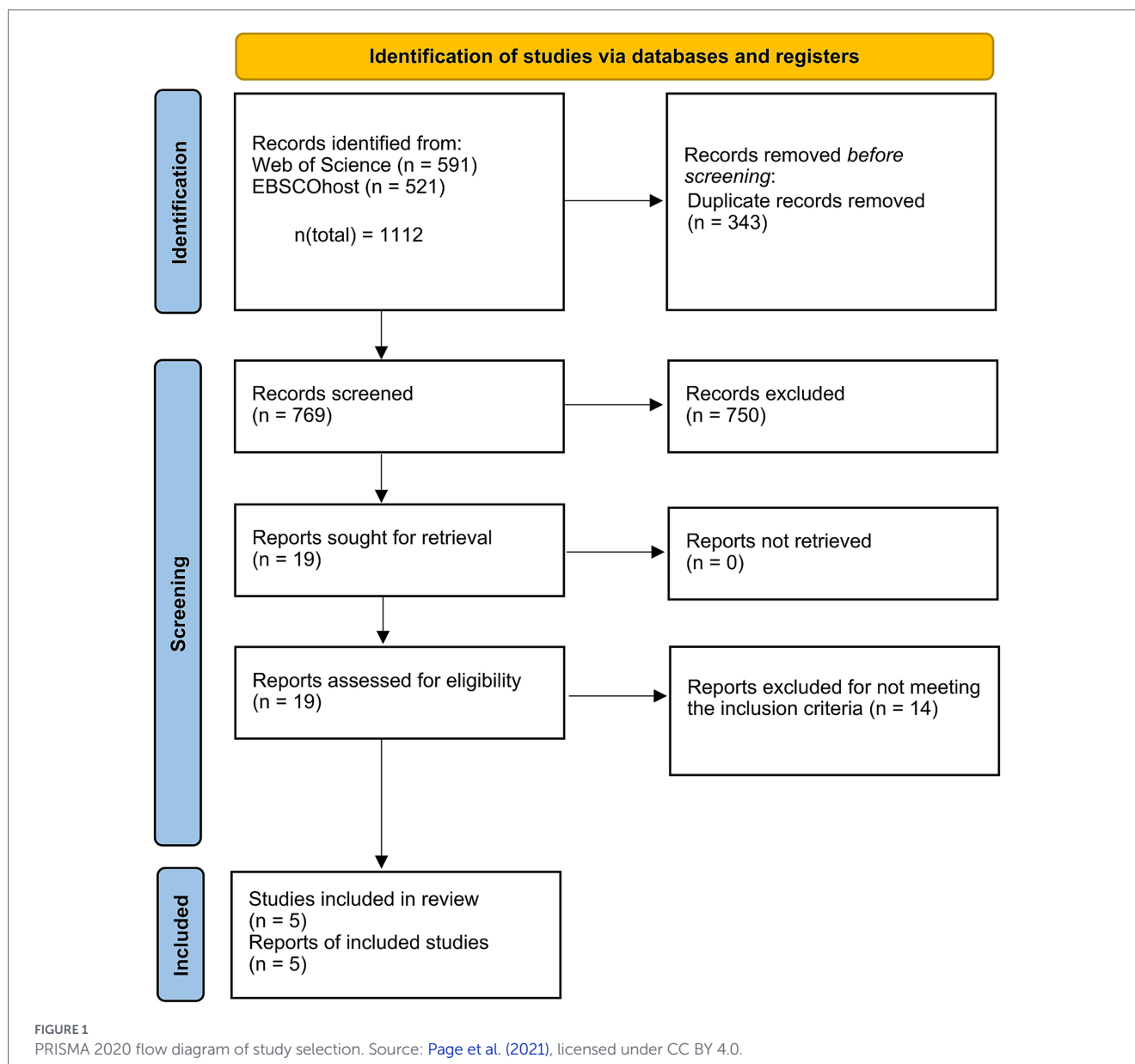
[Figure 1](#) (PRISMA flow) summarizes the selection process. After de-duplication and title/abstract screening of 769 unique records, 19 reports were advanced to full-text review. Following this process, five studies met the eligibility criteria and were included in the review. Fourteen full-text studies were excluded for the following reasons:

- No control group (e.g., [Ong et al., 2023](#); [Fantini et al., 2024](#); [Wu et al., 2023](#)).
- Delivered exclusively by outside professionals rather than school staff or peers (e.g., [Bağatarhan and Siyez, 2022](#)).
- Technology-based or mobile app interventions rather than school-embedded programs (e.g., [Haug et al., 2022](#)).
- Adult or young adult populations rather than school-aged children (e.g., [Emadi Chashmi et al., 2023](#)).
- Primary outcomes were unrelated to digital use. (e.g., [Therriault et al., 2023](#); [Greco et al., 2024](#)).

Thus, the final synthesis comprised five school-based studies in total, including three randomized controlled trials and two

TABLE 1 Characteristics of included studies.

Study (year)	Country	Objectives	Methods/design	Underlying theory	Overview of intervention	Sample (age/level)
<a href="#">Otsuka et al. (2023)</a>	Japan	Reduce problematic internet/smartphone use; improve readiness-to-change	Cluster RCT; teacher-delivered lessons; baseline + ~2 month follow-up	N/A	10 week hybrid curriculum: information, discussion, problem-solving, use-diaries	$n = 5,312$ ; grades 10–12 (upper secondary)
<a href="#">Gui et al. (2023)</a>	Italy	Test teacher-training + media-education to improve digital well-being	Cluster randomized trial; trained teachers deliver 4 modules; baseline + post	N/A	“Digital well-being schools”: planning tools, attention strategies, critical media tasks; teacher-family goal sharing	$n = 3,361$ students; ~80 teachers; upper secondary
<a href="#">Avci et al. (2023)</a>	Türkiye	Evaluate peer-education to reduce smartphone addiction symptoms	Quasi-experimental with control; baseline + immediate post	Social learning theory	Train peer leaders, they deliver 2 h class session + ongoing peer support	$n = 622$ ; grades 9–11 (high school)
<a href="#">Akgül-Gündoğdu and Selçuk-Tosun (2023)</a>	Türkiye	Test solution-focused group counselling for elevated PIU	Individual RCT (vs. waitlist); 6 group sessions over ~3 months	Solution-focused approach	Manualized small-group work: goal setting, solution-finding, homework	$n = 128$ ; ages 11–14 (lower secondary), YIAT $\geq 30$
<a href="#">Kacar and Ayaz-Alkaya (2022)</a>	Türkiye	Assess play-based substitution (traditional games)	Quasi-experimental with control; 8 weeks, 60 min in 3 weeks	N/A	Structured traditional group games during lunch and after school	$n = 42$ ; ages 8–11 (primary), >2 h/day recreational use



quasi-experimental studies with control groups (Otsuka et al., 2023; Gui et al., 2023; Avci et al., 2023; Akgül-Gündoğdu and Selçuk-Tosun, 2023; Kacar and Ayaz-Alkaya, 2022).

### 3.2 Study characteristics

Five trials were included, with a total sample of  $\approx 10,000$  students (ages 8–18). The five included trials ( $n \approx 10,000$ ) were conducted in Japan (Otsuka et al., 2023), Italy (Gui et al., 2023), and Türkiye (Avci et al., 2023; Akgül-Gündoğdu and Selçuk-Tosun, 2023; Kacar and Ayaz-Alkaya, 2022). Participants ranged from primary school children aged 8 to high school students aged 18. Interventions included teacher-delivered curricula, peer education, solution-focused counselling, and play-based substitution.

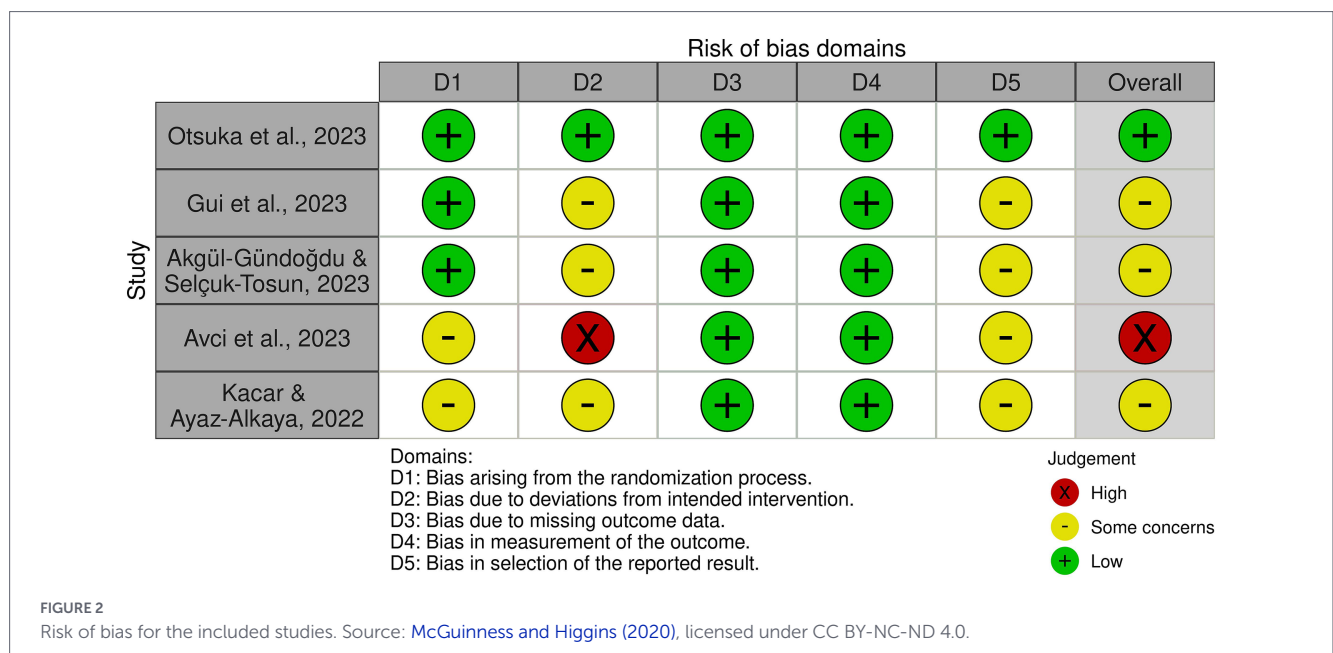
### 3.3 Risk of bias in studies

Risk of bias is presented in Figure 2. Cluster RCTs were at some risk due to self-report outcomes and short follow-up.

Quasi-experimental studies had risks due to non-random allocation and small samples.

### 3.4 Outcome measures

Across the included studies, problematic or addictive digital use was captured with validated self-report instruments as overviewed in Table 2. It is possible to categorize the outcome instruments in three areas: (1) severity of problematic use (primary outcome focus), (2) mediating behavioral factors (e.g., time/attention management, smartphone “pervasiveness”), and (3) broader psychosocial/health co-outcomes (e.g., well-being, social skills, lifestyle, perceived academic success). Primary endpoints were validated self-reports widely used with adolescents: the Smartphone Addiction Scale-Short Version (SAS-SV) (Kwon et al., 2013), Young’s Internet Addiction Test (YIAT-20) (Young, 1998; Pawlikowski et al., 2013), and the Korean Internet Addiction Proneness Scale (K-scale) (Mak et al., 2017). Different focuses (smartphone-specific vs. general PIU) limit direct comparability.



Secondary outcomes followed program logic: teacher-led curricula tracked pervasiveness, time-management, and perceived teacher support; selective counselling added health-behavior and academic self-perception indices, while play-based substitution used parent/child social skills, family-child internet problems and perceived stress. Most trials relied on self-report at the immediate post-test (one with short follow-up), so durability is uncertain.

### 3.5 Narrative synthesis of included studies

The five studies evaluated diverse school-based approaches to problematic digital technology use, spanning universal teacher-delivered curricula, peer-led education, selective group counselling, and a play-based substitution program. Due to the substantial heterogeneity in outcome measures (e.g., SAS-SV, YIAT, vs. time logs) and intervention designs, a statistical meta-analysis was not feasible. Findings are interpreted narratively by the delivery model.

#### 3.5.1 Universal, teacher-delivered curricula

Two large cluster trials assessed whole-class programs delivered by teachers. In Japan, Otsuka et al. (2023) implemented an intervention with high-school students, consisting of 10 weekly sessions, each lasting approximately 10 min, that combined information, classroom discussion and self-monitoring. Following the intervention, during the 2 month follow-up, no consistent reductions were detected on the K-scale or the SAS-SV. Small favorable shifts were observed in the stage of behavioral change (Transtheoretical Model).

In Italy, Gui et al. (2023) trained teachers so that they can deliver four media-education modules—Time and Attention Management, Communication and Collaboration, Information Evaluation, and Digital Content Production. Unlike one-off sessions by external trainers, the intervention provides a toolbox for autonomous classroom work and was co-designed with a steering committee of media-education experts, school leaders, and experienced teachers to enhance student well-being. The students in intervention schools showed some improvements: there was a moderate but significant reduction in the

use of smartphones during the day in the intervention group ( $-2.6, p = 0.001, ES = -0.183$ ), and fewer disturbances of adaptive functioning ( $-2.0, p = 0.006, ES = -0.117$ ). The biggest impact was the increase in the perceived teacher support compared with the control group ( $26.5, p < 0.001, ES = 0.873$ ). There were no gains in overall well-being or digital competence scores.

The programs improved indicators related to the intervention process (e.g., perceived support, readiness to change, pervasiveness subscales), but they did not consistently reduce validated addiction totals. Both trials were limited by self-report methodology and brief follow-up periods.

#### 3.5.2 Peer-led education

In a large Turkish high-school sample, Avci et al. (2023) trained selected students as peer educators, who then delivered a brief session and ongoing peer support on healthy smartphone use. The intervention was grounded in social learning theory, and after 3 weeks of training for peer educators, they conducted a two-hour training session on their own for their peers and continued to offer information and support for an additional 2 weeks. Compared with the control groups, the intervention group showed a large decrease on the SAS-SV from baseline  $29.04 \pm 10.64$  to post-test  $19.51 \pm 7.79$  ( $p < 0.001$ ). Peer educators themselves exhibited the largest within-person reductions; SAS-SV scores dropped from  $30.16 \pm 3.82$  before the program to  $15.58 \pm 4.02$  after the program ( $p < 0.001$ ). The effects were measured immediately after the post-intervention with no long-term follow-up. The use of a quasi-experimental, non-randomized design in a single context introduces a serious risk of bias across multiple domains (including selection/allocation and confounding). Therefore, while the significant direction and magnitude of the effect are noteworthy, the overall certainty of the evidence for this finding remains low.

#### 3.5.3 Selective, skills-focused counselling

Targeting students with elevated internet addiction scores, Akgül-Gündoğdu and Selçuk-Tosun (2023) delivered six

TABLE 2 Measures and outcomes.

Study (year)	Scales used	Results
Otsuka et al. (2023)	<i>Korean Internet Addiction Proneness Scale for adolescents (K-scale)</i> : a validated, cross-culturally adapted instrument specifically designed to measure the severity of Internet addiction symptoms.	Internet addiction scores: no significant effect 2 months post-intervention
	SAS-SV: a 10-item, widely used self-report tool measuring core behavioral addiction symptoms like withdrawal, functional disturbance, and tolerance related to smartphone use.	Smartphone addiction scores: no significant effect 2 months post-intervention
	<i>Transtheoretical model (TTM) stage</i> : a staging instrument that classifies individuals based on their motivation and intention to change a behavior (e.g., pre-contemplation, preparation). It measures a process indicator.	<i>Transtheoretical model stage</i> : minor, favorable shift in students' stage of change (e.g., moving from contemplation to preparation). Adjusted mean difference: 0.232 ( $p < 0.05$ ).
	<i>Self-reported internet usage time</i> : a direct measure of the number of hours/time spent on the Internet.	Internet usage: no significant change in the total number of hours spent using the internet.
Gui et al. (2023)	SAS-SV and <i>Smartphone Addiction Proneness Scale</i> : measured two sub-dimensions: disturbance of adaptive functions and withdrawal.	<i>Teacher support</i> : highly significant increase in perceived teacher support (26.5, $p < 0.001$ ), demonstrating a large effect size (ES = 0.873).
	<i>Smartphone Pervasiveness Scale for adolescents (SPS-A)</i> : assessed the frequency of device use during specific times that are easily disrupted (e.g., while studying, at dinner, with friends).	<i>Smartphone use frequency</i> : moderate but significant reduction in the frequency of smartphone use at relevant times ( $-2.6$ , $p = 0.001$ , ES = $-0.183$ ).
	<i>Perceived teacher support (Ad hoc battery)</i> : measured students' exposure to media education activities and their feeling of receiving specific forms of help from teachers regarding digital media use.	<i>Functional disturbances</i> : significant decrease in mobile media-related disturbances to adaptive functions ( $-2.0$ , $p = 0.006$ , ES = $-0.117$ ).
	<i>Digital competence test</i> (standardized test): assessed students' digital competence through 32 multiple-choice items based on realistic smartphone/web situations.	The total addiction score and the withdrawal subscale did not show a significant reduction. Digital competence: no significant improvement was reported.
	<i>Capital-enhancing internet and digital media use</i> : measured media use strategies focused on increasing social and cognitive opportunities (e.g., using media for learning or social capital).	The use of media for increasing social or cognitive opportunities: No significant change reported <i>Satisfaction with life significant</i> : small favorable effect for females (Effect: 1.8, $p = 0.021$ , ES = 0.123), with a significant interaction term of 2.9 ( $p = 0.050$ ).
	<i>Satisfaction with Life Scale</i> : measured overall life satisfaction using five items for self-assessment.	No significant effect on students' overall life satisfaction.
	Avci et al. (2023)	SAS-SV: A well-validated measure of addiction symptoms, including withdrawal, tolerance, and functional disturbance.
Post-test scores were statistically significant between intervention and control groups ( $p < 0.001$ ).		
Akgül-Gündoğdu and Selçuk-Tosun (2023)	YIAT-20: a 20-item instrument measuring the severity of addiction across eight criteria (e.g., tolerance, preoccupation, neglect of duty).	<i>Internet addiction scores</i> : a significant reduction from pre-test $M = 35.65$ to post-test $M = 17.07$ ( $p < 0.01$ ).
	<i>Nutrition-Exercise Attitude Scale (NEAS)/Nutrition-Exercise Behavior Scale (NEBS)</i> : assesses self-reported attitudes and engagement in nutrition and physical activity.	<i>Nutrition-exercise attitudes and behaviors</i> : statistically significant differences between the posttest groups ( $p < 0.05$ )
	<i>Perceived academic success</i> : measures students' self-assessment of their academic performance and achievement.	<i>Perceived academic success</i> : statistically significant differences between the posttest groups ( $p < 0.05$ )
Kacar and Ayaz-Alkaya (2022)	<i>Family-Child Internet Addiction Scale by Young</i> : rated by parents. Focuses on internet-related addiction symptoms and specifically tracks daily/weekly usage time.	<i>Internet use</i> : significant reduction in daily and weekly internet use in intervention groups ( $p < 0.05$ ). Moderate effect size for weekly use ( $\chi^2 = 9.0$ , $p = 0.004$ )
	<i>Social skills were evaluated with two scales: (1) Social Skills Assessment Scale</i> : social skills rated by parents. Skills consisted of 12 sub-categories. (2) <i>Social Skills Scale</i> : self-reported by children, measures social skill behaviors.	<i>Social skills</i> : significant improvement in intervention group ( $p < 0.055$ ). Moderate to high effect size post-test.
	<i>Perceived Stress Scale in Children</i> : self-reported assessment of stress during the last week.	<i>Stress level</i> : no significant differences were found within or between groups

solution-focused approach group meetings over a three-month period. Within the solution-focused approach (SFA), students exhibiting problematic internet use were invited to voice desired outcomes for their online behavior and were guided to set specific, achievable goals. Compared to the control group, the intervention participants demonstrated large reductions on the YIAT (pre-test mean: 35.65, post-test mean: 17.07;  $p < 0.01$ ). There were also improvements in health-behavior attitudes and behaviors, as well as higher perceived academic success. The trial was randomized, but small and unregistered, with self-report outcomes and short follow-up—thus creating some concerns for reporting bias - yet the pattern of effects was internally consistent across domains.

### 3.5.4 Play-based substitution (traditional games)

With Turkish primary school pupils engaging in frequent recreational internet use, [Kacar and Ayaz-Alkaya \(2022\)](#) implemented an eight-week program of traditional games (three 60 min sessions per week). The games were played during lunchtime and after school. Compared with controls, the intervention group showed reduced internet-use time ( $p < 0.05$ ) and improved social skills (child- and parent-rated). There was no change in perceived stress. Small sample size, quasi-experimental allocation, and parent-report components place this study at serious risk of bias, but it indicates a plausible substitution pathway via structured offline activity.

### 3.5.5 Cross-study patterns

Across designs, interactive, competency-building, developmentally attuned, and socially embedded programs—such as peer-facilitated sessions ([Avci et al., 2023](#)), brief counselling with guided practice ([Akgül-Gündoğdu and Selçuk-Tosun, 2023](#)), and age-appropriate play-based substitution ([Kacar and Ayaz-Alkaya, 2022](#))—were associated with the most pronounced reductions on validated addiction measures. Teacher-delivered universal curricula appeared to shift proximal mechanisms (awareness, perceived support, time-management proxies) more than they reduced clinical indices of problematic use over the short term ([Gui et al., 2023](#); [Otsuka et al., 2023](#)). However, heterogeneity in measures, brief follow-ups, reliance on self-report, and limited preregistration constrain certainty, particularly for the peer-led and play-based studies.

## 3.6 Risk and protective factors addressed

Across the five included trials, interventions targeted a range of risk and protective factors associated with problematic internet and smartphone use. Universal classroom curricula ([Otsuka et al., 2023](#); [Gui et al., 2023](#)) primarily targeted excessive use, low awareness of health consequences, and weak time-management skills, while fostering protective factors such as digital literacy, reflective self-monitoring, problem-solving, and self-regulation through tools like using diaries and attention-management plans. The peer education model ([Avci et al., 2023](#)) aimed to reduce symptoms of smartphone addiction and counteract negative peer influence by using positive peer support, enhancing communication skills, and fostering a sense of belonging. The solution-focused counselling program ([Akgül-Gündoğdu and Selçuk-Tosun, 2023](#)) was directed at high-risk students, addressing emotion regulation difficulties and unhealthy

lifestyle behaviors while promoting goal setting, solution-oriented thinking, healthier nutrition-exercise habits, and improved academic self-perceptions. Finally, the traditional games intervention ([Kacar and Ayaz-Alkaya, 2022](#)) targeted excessive daily internet use, sedentary lifestyles, and social skill deficits, offering protective factors in the form of structured physical activity, cultural belonging, and enhanced peer interaction.

## 4 Discussion

This systematic review evaluated school-based interventions for problematic digital technology use, specifically focusing on programs delivered by existing school personnel. By utilizing the EUPC Etiology Model as a theoretical anchor, we sought to determine how these programs shift modifiable risk factors and strengthen protective capacities within the school micro-context.

This review found surprisingly little robust, school-deliverable trials on preventing or reducing problematic digital technology use. Although problematic use is widely discussed and increasingly prevalent, only five eligible school-based trials delivered by school personnel met inclusion criteria. This scarcity, together with heterogeneity of outcomes, limited theory use, brief follow-up, and frequent reliance on self-report, represents a central finding: there is a gap of school-based interventions and a need for better-designed, developmentally appropriate, and scalable school interventions.

Across the constrained evidence base of five school-based trials aimed at reducing problematic internet or smartphone use among adolescents, the findings revealed a consistent pattern regarding the types of interventions that showed promise. Selective, skills-based interventions—including peer-led education ([Avci et al., 2023](#)), solution-focused group counselling ([Akgül-Gündoğdu and Selçuk-Tosun, 2023](#)), and traditional play-based substitution ([Kacar and Ayaz-Alkaya, 2022](#))—showed promise of short-term reductions in validated addiction scores such as the SAS-SV and the YIAT-20. These outcomes align with broader evidence suggesting that interventions targeting psychosocial drivers, such as self-regulation, social connectedness, and coping skills, tend to yield greater behavioral change ([Throuvala et al., 2019](#); [Xu et al., 2021](#)).

By contrast, universal, teacher-delivered curricula ([Otsuka et al., 2023](#); [Gui et al., 2023](#)) showed only modest improvements in intermediate variables, such as readiness to change, time management, and perceived teacher support, and had a limited impact on validated clinical indicators of problematic use. While these programs were effective in increasing digital awareness and shifting attitudes, they did not consistently result in behavior change, highlighting the known limitations of information-heavy or passive instruction formats ([Romero Saletti et al., 2021](#)).

However, interpretation of these findings requires caution. While one included study reported large benefits of a peer-led model, this result should be considered in light of the EUPC ([European Monitoring Centre for Drugs and Drug Addiction, 2019](#)), which concludes that the evidence base for peer-led prevention remains weak compared with structured, adult-led delivery. Peer influence is undoubtedly powerful during adolescence, but relying on peers as primary facilitators raises concerns about fidelity, supervision, and sustainability. On balance, this review supports the EUPC's position

that peer-led interventions should be regarded as experimental and context-dependent, rather than established evidence-based strategies. In addition, the study had problems in several domains related to the risk of bias.

Beyond effectiveness, the identified patterns reveal how these programs worked by shifting modifiable risks and strengthening protective factors, a strategy central to the EUPC. The interventions could be placed onto two broad protective pathways: strengthening self-regulatory capacities (e.g., monitoring, planning and goal-directed coping) (Otsuka et al., 2023; Gui et al., 2023; Akgül-Gündoğdu and Selçuk-Tosun, 2023) and increasing protective contexts or alternatives (e.g., peer support, belonging and rewarding offline activity) (Avci et al., 2023; Kacar and Ayaz-Alkaya, 2022). However, only three trials assessed intermediate, theory-adjacent outcomes alongside addiction measures—stage of change (Otsuka et al., 2023), perceived teacher support (Gui et al., 2023) and social skills (Kacar and Ayaz-Alkaya, 2022). Meaning that most hypothesized pathways were inferred rather than tested. Prevention theory posits that protective factors buffer risks such as emotion dysregulation, poor self-control and maladaptive escapism, and that these mechanisms are shaped within adolescents' micro-contexts (family, peers and school) (European Monitoring Centre for Drugs and Drug Addiction, 2019; Ostendorf et al., 2020; Do and Kim, 2024). It also suggests a challenge on universal classroom programs: even when awareness or motivation improves, durable behavior change may depend on reinforcement beyond school, including family processes such as parental warmth, supervision and open communication that support internalization of healthy routines (Faltýnková et al., 2020).

In conclusion, this review suggests that non-clinical, school-based interventions can help reduce problematic digital technology use in adolescents. The more promising approaches—particularly peer-led education, counselling models, and play-based programs—shared a common focus on building psychosocial skills, promoting self-reflection, and offering meaningful offline alternatives. Universal curricula can improve digital awareness but are less likely to shift entrenched behavioral patterns unless they also engage students interactively and developmentally.

#### 4.1 Limitations of the included evidence

Several limitations of the included studies constrain confidence in the conclusions. Most trials relied exclusively on self-report questionnaires, which are susceptible to recall bias and social desirability effects. Only short-term outcomes (immediate post-test, and in one case a 2 month follow-up) were reported, leaving long-term effectiveness unknown. Opportunities for statistical synthesis were limited, and comparisons were made indirectly, due to the wide variation in outcome measures used across studies (e.g., K-scale, SAS-SV, YIAT, pervasiveness scales, and parent-rated indices).

#### 4.2 Limitations of the review process

This review also has limitations. The small number of eligible trials restricted the ability to conduct robust quantitative meta-analyses or to test publication bias formally. The eligibility criteria excluded many studies that could be useful in school settings but are not deliverable by school personnel. Grey literature and non-English reports were not systematically searched, potentially

missing relevant studies. Additionally, because all screening and extraction were based on published manuscripts, unpublished data could not be verified.

#### 4.3 Implications for practice, policy, and future research

The findings have several implications. The most substantial being, that there is a clear need for theory-driven, rigorously tested school-based interventions. For practice, schools should be cautious about relying solely on informational approaches; instead, programs that foster self-regulation, digital literacy, and peer engagement are more likely to produce meaningful reductions in problematic use. For policy, these results support integrating digital well-being into broader health-promotion and educational strategies and embedding preventive work into the school curriculum rather than treating it as an add-on. To advance the field, future research should:

- Apply consistent behavioral theories across intervention types
- Measure mediating variables to trace change mechanisms
- Evaluate fidelity and implementation quality
- Extend follow-up periods to assess long-term outcomes
- Explore how interventions can be tiered and integrated into wider school well-being strategies

Future work should also evaluate cost-effectiveness and the scalability of interventions, given the need for sustainable policy implementation at the population level.

#### Data availability statement

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

#### Author contributions

LO: Data curation, Conceptualization, Visualization, Investigation, Methodology, Formal analysis, Writing – original draft. GA: Writing – review & editing, Investigation, Methodology, Conceptualization. KA: Conceptualization, Writing – review & editing, Methodology, Investigation. PO: Methodology, Supervision, Conceptualization, Writing – review & editing, Investigation, Project administration, Funding acquisition.

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## Conflict of interest

The author(s) declared that this work 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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