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Educational leadership under construction: an experimental study on emotions and task performance using LEGO® bricks

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Introduction: This study explored the impact of transformational and transactional leadership styles on emotional climate, task performance, and time perception in a university educational context. Additionally, it analyzed the evolution of emotional climate throughout a group activity focused on collaborative LEGO figure construction.

Method: A quasi-experimental design was implemented with 93 university students divided into 23 groups. Each group completed two construction tasks under distinct leadership conditions: one focused on the final outcome (transactional) and the other on process facilitation (transformational). Emotional climate (positive and negative) was assessed at three time points (beginning, midpoint, and end), along with task performance, time perception, and qualitative reflections on the experience in both leadership conditions.

Results: The findings showed that transformational leadership fostered a sustained increase in positive emotional climate, improved task performance, and greater satisfaction with the activity. In contrast, transactional leadership was associated with a progressive increase in negative emotions, lower construction accuracy, and higher perceptions of emotional discomfort. Qualitative responses reflected that in both cases the experiences were collaborative, motivating, and playful. However, under transformational leadership more positive emotions were experienced, whereas under transactional leadership, due to greater perceived difficulties in task execution, negative emotions such as frustration and stress increased.

Discussion: The results highlight the pedagogical value of transformational leadership in promoting positive emotional climates and effective collaborative learning environments. Its integration into teacher education programs is recommended as a strategy to enhance students' socioemotional wellbeing and academic engagement.

KEYWORDS

transformational leadership, transactional leadership, emotional climate, cooperative learning, higher education, task performance

1 Introduction

Leadership in educational settings is a key determinant of the quality of teaching and learning processes, student wellbeing, and the effectiveness of teaching teams (Day et al., 2016; Hallinger, 2011). In today's educational environments, characterized by increasing pedagogical complexity, classroom diversity, and growing demands for socioemotional competencies, leadership is increasingly recognized not merely as an administrative function but as a transformative capacity that directly impacts classroom dynamics and institutional culture (OECD, 2019; Schleicher, 2018).

The TALIS report (Teaching and Learning International Survey; OECD, 2019) emphasizes that school leadership can exert a direct influence on the quality of teaching, learning, and students' emotional wellbeing (Leithwood and Jantzi, 2008; Tschannen-Moran and Gareis, 2004). Within this framework, growing attention has been given to how leadership styles affect cooperative learning processes, particularly in relation to emotional climate, a variable that is central to shaping the quality of the learning experience (Pekrun and Linnenbrink-Garcia, 2012).

Emotional climate is defined as the set of shared emotions that emerge within a group in response to a specific task (Pekrun, 2006). Its influence is critical, as it affects performance, decision-making, collaboration, time perception, and task satisfaction (Asri et al., 2025; Pekrun and Linnenbrink-Garcia, 2012). Groups with a positive emotional climate show greater cohesion, deal more effectively with challenges, and achieve superior performance (Greenidge and Coyne, 2014). Research suggests that leadership style is a decisive factor in generating such shared emotions, fostering in some cases more positive climates and in others more rigid or tense group dynamics.

Among the most studied leadership styles in education are transformational and transactional leadership (Bass and Riggio, 2006; Judge and Piccolo, 2004). Transformational leadership, through shared vision, intellectual stimulation, individualized consideration, and inspirational motivation, has been shown to enhance emotional engagement, creativity, and group cohesion (Avolio and Bass, 2004; Leithwood and Jantzi, 2005). In contrast, transactional leadership emphasizes supervision and contingent rewards, proving effective in structured tasks but limited in contexts requiring innovation or emotional regulation (Lowe et al., 1996; Podsakoff et al., 2006).

Numerous studies have emphasized the potential of transformational leadership to promote positive emotional climates, reduce conflict, and enhance resilience and commitment in school settings (Berkovich and Eyal, 2021; Hallinger, 2011). However, there is limited experimental evidence exploring how these leadership styles influence emotional climate in real time during cooperative tasks, especially those that demand coordination, emotional regulation, and collective problem-solving.

The present study seeks to address this gap through an experimental repeated-measures design examining how transformational and transactional leadership styles influence emotional climate, task performance, and time perception during a cooperative LEGO-building activity. LEGO-based tasks have been established as an effective methodology that integrates cognitive, social, and emotional dimensions through play (ElKelish and Ahmed, 2021; Garden, 2022), providing an ideal setting to explore how play shapes the challenges of educational organizations, particularly in how leadership regulates group dynamics and emotions in real time.

1.1 Transformational vs. transactional leadership in education

Transformational and transactional leadership styles are part of the Full Range Leadership Model proposed by Bass and Avolio (1994). In educational contexts, transformational

leadership has garnered increasing attention due to its capacity to foster emotionally positive, collaborative learning environments centered on students' holistic development. This leadership style is structured around four core dimensions: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration (Bass and Riggio, 2006).

First, idealized influence refers to the leader serving as a role model, guided by a clear vision, strong values, and self-confidence. This dimension fosters admiration, respect, and commitment among team members (Lan et al., 2019). Second, inspirational motivation pertains to the leader's ability to communicate shared goals in an enthusiastic and persuasive manner, generating optimism, group cohesion, and a sense of purpose among both teachers and students (Budur and Poturak, 2021). Through clear and purposeful communication, transformational leaders mobilize their teams toward challenging goals, overcoming obstacles and adapting with resilience and flexibility to changing contexts, thereby achieving substantial academic improvement (Berkovich, 2020).

Third, intellectual stimulation encourages a climate of critical thinking and innovation, promoting educators and learners to question assumptions, propose creative solutions, and make autonomous decisions. This dimension has proven particularly effective in catalyzing pedagogical innovation and adapting to increasingly complex and dynamic educational settings (Martínez, 2014).

Finally, individualized consideration is expressed through the leader's personalized attention to each group member, recognizing their unique characteristics, strengths, and developmental needs (Gorgulu, 2019). This practice promotes inclusive and cooperative learning environments, fostering intrinsic motivation and contributing positively to students' emotional wellbeing and academic performance (Shen et al., 2020).

A growing body of research has demonstrated that transformational leadership is associated with greater professional satisfaction, increased teacher commitment, reduced burnout, and improvement of organizational culture in schools (Avcı, 2015; Berkovich and Eyal, 2021). Additionally, this leadership style positively influences the development of emotional intelligence in both teachers and students (Flores, 2023). By promoting empathy, active listening, and emotional validation, transformational leaders help create positive affective climates in which individuals feel understood, safe, and valued (Rojas-León et al., 2023; Valdés and Pérez, 2023). All of this fosters an educational setting conducive to meaningful learning, genuine collaboration, and socio-emotional development for all members of the educational community.

In contrast, transactional leadership is grounded in a logic of exchange, in which the relationship between leader and subordinates is based on conditional rewards and oversight of rule and goal compliance (Bass, 1985). This style is characterized by active supervision, correction of deviations, and performance driven by a system of rewards and punishments (Bass and Avolio, 1994). Specifically, it is structured around two key dimensions: goal attainment and management-by-exception. The transactional leader establishes expectations and targets without providing ongoing guidance and may deliver critical feedback based on failure to meet predefined agreements (Lan et al., 2019).

In educational contexts, transactional leadership can be useful in ensuring organizational efficiency and the completion of

specific academic tasks (Sheena et al., 2025). Indeed, some studies have shown that contingent reward, that is, rewards explicitly conditioned on the achievement of previously established objectives, constitutes a central dimension of this style and can be effective in contexts involving structured tasks and clear performance criteria, fostering accountability and goal attainment (Jung and Avolio, 2000; Podsakoff et al., 2006). However, when applied in isolation, this leadership style can limit autonomy, hinder pedagogical innovation, and reduce students' intrinsic motivation (Judge and Piccolo, 2004; Lowe et al., 1996). Moreover, it has been associated with school climates characterized by emotional tension, low affective engagement, and a general sense of demotivation, particularly in contexts requiring collaboration, creativity, and shared problem-solving (Leithwood and Jantzi, 2008).

From an integrative perspective, scholars have argued that transactional leadership can complement transformational leadership by providing normative clarity and ensuring the achievement of objectives, particularly in routine or administrative tasks within schools (Abbas and Ali, 2023). In contrast, transformational leadership is more suitable for fostering pedagogical innovation, collaboration, and the renewal of school culture. In this sense, the effectiveness of each style depends on contextual characteristics, reinforcing the need for a hybrid approach that strategically combines structure with motivation, control with inspiration, and efficiency with emotional wellbeing (Hallinger and Wang, 2015).

The study of school leadership in relation to emotional climate remains an emerging field of research (Goetz et al., 2024). Yet advancing in this area is crucial, as leadership practices not only shape organizational functioning but also influence the daily emotional experiences of teachers and students. These experiences, in turn, play a decisive role in the quality of the school climate, in students' readiness to learn, and in the overall wellbeing of the educational community.

1.1.1 Positive and negative emotional climate

Emotional climate is defined as the set of shared emotions that emerge within a group during a specific activity, shaping perceptions of the environment, collective performance, and the quality of social interactions (Fernández-Dols et al., 2007; Páez et al., 1997). This group-level affective dimension functions not only as a reflection of contextual conditions but also as a regulator of both individual and collective behaviors (Rimé, 2007). In educational settings, emotional climate has been identified as a key predictor of academic engagement, school satisfaction, and student achievement (Pekrun and Linnenbrink-Garcia, 2012).

According to the Emotional Climate Scale developed by Páez et al. (1997), this construct comprises two main dimensions: positive emotional climate, characterized by emotions such as happiness, calmness, surprise, hope, and trust, and negative emotional climate, which includes emotions like fear, sadness, and anger. Both dimensions have important practical implications: a positive climate enhances cooperation, emotional self-regulation, and perceptions of group efficacy, whereas a negative climate can

lead to demotivation, stress, and the deterioration of interpersonal relationships (Rodríguez et al., 2015; Páez et al., 2004).

Affective Events Theory (Weiss and Cropanzano, 1996) provides a valuable framework for understanding how leadership shapes these dynamics. According to this theory, events occurring in the immediate environment trigger emotional reactions that, in turn, influence attitudes and behaviors. Leadership acts as a contextual moderator of both the intensity and the meaning attributed to such events (Botsford Morgan et al., 2018). Transformational leaders, by fostering trust, motivation, and a shared vision, can buffer the effects of demanding situations, making them appear less threatening and thereby reducing the likelihood of negative emotions. Furthermore, this style promotes a supportive and positive exchange climate that strengthens group cohesion and collective goal orientation (Ashkanasy and Tse, 2000; Walter and Bruch, 2009; Judge and Piccolo, 2004).

In contrast, transactional leadership, primarily focused on contractual exchange and supervision, may secure the fulfillment of immediate objectives but, when applied without a transformational component, tends to intensify perceptions of unfair demands, fostering frustration or resentment and ultimately weakening the emotional climate (Holtz and Harold, 2008; Judge and Piccolo, 2004). Although this style can ensure basic compliance, it is generally less effective in tasks that require flexibility, cooperation, and creative problem-solving (Bass, 1985; Lowe et al., 1996).

Transformational leadership has also been linked to higher intrinsic motivation and deeper engagement with the task (Bass and Avolio, 1994). Under such conditions of strong involvement, close to the state of flow, the perception of time tends to be more balanced and adequate (Csikszentmihalyi, 1990). By contrast, transactional leadership, with its emphasis on external supervision and control, may hinder intrinsic motivation and increase the likelihood of perceiving the allocated time as insufficient or inadequate (Pekrun, 2006).

From this perspective, the present study experimentally examines how transformational and transactional leadership styles influence emotional climate (i.e., both positive and negative) alongside time perception, task performance, and students' subjective experiences during a cooperative LEGO block-building activity. Such tasks provide an ideal context to observe, in real time, how leadership behaviors shape group emotional climate, performance outcomes, and perceptions of the time allocated for task completion (Gómez de Quero et al., 2025; Warburton et al., 2022).

In line with the literature, the following hypotheses are proposed: *Hypothesis 1*: Transformational leadership will be associated with an increase in positive emotional climate and a decrease in negative emotional climate over the course of the task (i.e., beginning, middle, and end).

Hypothesis 2: Transactional leadership will be associated with lower levels of positive emotional climate and higher levels of negative emotional climate during the task (i.e., beginning, middle, and end).

Hypothesis 3: Students who experience a more positive emotional climate during the cooperative task will demonstrate higher performance and a more adequate perception of the

time available than those who experience a more negative emotional climate.

This study seeks to contribute to the understanding of the role of leadership in students' emotional experiences, offering empirical evidence on how different leadership practices affect not only outcomes but also the affective climate within cooperative educational contexts.

2 Method

2.1 Study design

This study employed a quasi-experimental design to examine students' emotional experiences and performance during a collaborative task under two classroom leadership conditions: transactional and transformational leadership. The central activity involved constructing figures using LEGO bricks, providing a practical and cooperative context to observe group dynamics and assess how each leadership style influences emotional climate and team performance.

Two experimental conditions were established:

1. **Outcome-focused leadership (transactional style):** In this condition, the facilitator adopted an approach focused solely on the final product. Each team received only the image of the completed LEGO model, without step-by-step instructions or additional guidance. The facilitator acted as a transactional leader, establishing a clear goal without providing support during the process.
2. **Process-focused leadership (transformational style):** In this condition, the facilitator provided detailed instructions and continuous support throughout the activity, adopting a collaborative, motivational, and guided approach in line with the principles of transformational leadership (Bass and Riggio, 2006; Podsakoff et al., 1990).

Before the experimental sessions began, all facilitators completed a standardized training program designed to ensure the accurate and consistent implementation of both leadership conditions. To ensure consistency in the implementation of both experimental conditions, facilitators received prior standardized training that included detailed scripts specifying the verbal and non-verbal behaviors characteristic of each leadership style. They also took part in supervised role-playing sessions in which they practiced enacting both styles and received immediate feedback from the research team. This preparation ensured a consistent and accurate representation of the leadership conditions across groups and minimized potential variability in facilitator behavior. The same facilitator remained with each group across both conditions to control for potential external variables related to individual differences.

To reduce potential biases and strengthen the internal validity of the study, the following methodological decisions were implemented:

Distinct tasks for each condition: To avoid learning effects, familiarity, or direct transfer between conditions, two different LEGO figures were used, one for the transactional condition and another for the transformational condition. Both figures were

selected to be equivalent in difficulty in terms of the number of pieces, structural complexity, and estimated construction time. This ensured that any observed differences could be attributed to the leadership style rather than the nature of the task. The order of presentation was fixed: the transactional condition was conducted first, followed by the transformational condition.

Fixed order of conditions. The order of presentation was fixed: the transactional condition was always conducted first, followed by the transformational condition. This decision was based on methodological considerations. Beginning with the transactional condition, where facilitators only displayed the image of the final model and adopted a directive, outcome-oriented approach, allowed participants to organize and coordinate within their teams autonomously to achieve a common product. Conducting the transformational condition second ensured that this subsequent experience, characterized by guided instruction, positive feedback, and motivational support, did not influence performance in the initial condition. This sequence also helped minimize potential carryover or contamination effects between tasks, thereby enhancing methodological consistency and experimental control.

Within-subjects design: The same student teams participated in both experimental conditions, allowing for direct comparison of their responses to different leadership styles without the influence of intergroup variability.

Time allotted for the LEGO construction task: Pilot testing indicated that 30 min was an adequate duration for groups of four to complete models of approximately 130 pieces, ensuring the feasibility of the task while also simulating realistic time pressure conditions that facilitated the observation of leadership dynamics. These were low-difficulty models that a single individual could complete in about 30–35 min; however, in groups of four the process was considerably accelerated through task division (e.g., sorting, searching for pieces, assembling). This time limit not only guaranteed the feasibility of the exercise but also enhanced the manifestation of differences in how teams managed the activity under the two leadership styles.

These methodological choices enabled a controlled assessment of how teams respond to distinct leadership approaches while performing comparable tasks (i.e., different but equivalent LEGO figures), minimizing the risk of memory or repetition effects.

This design enabled a controlled analysis of the impact of two leadership styles on emotional variables and task performance in a collaborative educational setting.

2.2 Participants and procedure

The study sample comprised 93 undergraduate students enrolled in the Teacher Education program at a public Spanish university. The average age was 22 years ($SD = 3.12$). The majority were female (89%), which reflects the typical gender distribution in teacher education programs in Spain and other European countries (OECD, 2019).

For the implementation of the experimental conditions, students were organized into 23 working groups, each composed of four members. This size, frequently used in cooperative learning and group dynamics research (Forsyth, 2019), was

considered particularly suitable for LEGO construction tasks, as it balanced diversity of input with efficient coordination and ensured active participation from all members within the allotted time. Group composition remained constant across both experimental conditions (i.e., first the transactional condition and second the transformational leadership condition). In addition, 23 trained facilitators (one per group) assumed the assigned leadership role. To ensure consistency, facilitators received prior training that guaranteed the homogeneous implementation of the leadership conditions. Although their role was essential to the experimental design, facilitator performance data were not analyzed, as the study focused on students' emotional experiences and task performance.

All participants were informed in advance about the study's objectives, the nature of the tasks, and their voluntary participation. Confidentiality was guaranteed, and participants were allowed to withdraw at any point. Informed consent was obtained from every participant, in line with ethical standards for research involving human subjects in educational settings.

The experimental design was implemented across four sessions, each organized and supervised by the research team. Approximately five to six groups participated per session, and each group completed both experimental conditions sequentially within a single 90-min session. This structure enabled efficient time and resource management, while ensuring consistent supervision and procedural control across all groups.

At the beginning of each session, participants were given a general overview of the activity's goals, emphasizing its collaborative nature and connection to teamwork and leadership processes. Specific details about the experimental conditions were withheld to minimize expectation-related biases. Groups were seated at tables arranged to facilitate interaction, cooperation, and coordination among members, thereby fostering an environment conducive to teamwork.

During each session, groups completed two LEGO construction tasks, each aligned with a different leadership style. Both tasks were limited to 30 min. Although the LEGO figures differed across conditions, they were matched in terms of the number of pieces and level of difficulty, which helped control for familiarity, memory effects, or transfer of strategies between tasks. A brief break was provided between the two tasks to reduce fatigue and minimize carryover effects from the first task to the second.

Regarding the administration of instruments, procedures were identical across both leadership conditions. Students completed the Emotional Climate Scale at three time points: before beginning the task (T1), midway through the task (after 15 min of group work; T2), and immediately upon completion (T3). After each condition, students completed the remaining items in the questionnaire, as outlined in the instruments section. In addition to the self-report measures, the researchers independently recorded each group's task performance throughout the activity. Using a structured observation sheet, they noted whether each team had successfully completed, partially completed, or failed to complete the LEGO figure. These observations were carried out in real time and verified immediately after task completion, providing an objective cross-check of the groups' self-reported performance.

All sessions were conducted by the same research team, ensuring uniformity in protocol implementation and rigorous control over experimental conditions. All groups participated under similar physical and environmental settings.

2.3 Instruments

An *ad hoc* questionnaire was developed, combining previously validated scales with newly constructed items, with the aim of collecting both quantitative and qualitative information regarding participants' experiences. Initially, basic sociodemographic data were included, such as gender, in order to characterize the sample and allow for exploratory analysis of potential individual differences.

Next, a series of descriptive items was designed to assess participants' perceptions of the time allocated for the task and their performance in building the LEGO figure. These items were developed *ad hoc* by the authors to capture participants' immediate evaluation of these specific and directly observable constructs. An open-ended question was also included to capture participants' qualitative evaluations of their experience during the LEGO activity. Although single-item indicators may raise concerns about reliability, prior research suggests that they are appropriate when constructs are narrow, concrete, and clearly defined (Allen et al., 2022). Given the specificity and direct observability of these constructs (e.g., adequacy of the allocated time; correspondence between the LEGO model and the reference figure), the use of single-item measures was deemed suitable in this study.

The specific items were as follows:

Perception of allocated time. A closed-ended question (developed by the authors) assessed whether the time allocated for the task (30 min) was perceived as adequate. Response options were: 1 = We had extra time, 2 = The time was sufficient, and 3 = We ran out of time.

Task performance. One item (developed by the authors) evaluated the degree of correspondence between the constructed LEGO figure and the projected model. Response options were: 1 = The figure was not successfully built, 2 = Partial construction, and 3 = Perfect construction of the figure.

Open-ended question on the experience. To gather qualitative insights, participants were prompted to summarize their experience with the LEGO construction: "In one sentence, summarize your experience with the LEGO figure you built." To ensure confidentiality and anonymity, an alphanumeric coding system was used in which each participant was identified with the letter "P" followed by a number. For example, "1" refers to participant number 1 who provided qualitative data.

Finally, the Emotional Climate Scale (ECE) developed by Páez et al. (1997) was administered. This instrument comprises six items that assess two dimensions: positive emotional climate (happiness, surprise, and calm) and negative emotional climate (anger, sadness, and fear). Responses were recorded on a five-point Likert scale (1 = not at all, 5 = very much). In the current sample, the scale demonstrated acceptable internal consistency ($\alpha = 0.71$).

2.4 Data analysis

The statistical analysis was conducted using IBM SPSS Statistics version 29.0. Initially, descriptive statistics, including mean,

standard deviation, skewness, and kurtosis, were calculated for all study variables to assess data distribution and suitability for further inferential analyses. The normality of the data was examined through the Kolmogorov-Smirnov and Shapiro-Wilk tests, which indicated significant deviations from a normal distribution ($p < 0.05$). Consequently, non-parametric procedures were applied. Specifically, Spearman's rank-order correlations (ρ) were computed among the main study variables (i.e., emotional climate, time perception, task performance, and time invested) to explore their interrelations.

From a descriptive standpoint, the influence of the two experimental conditions (i.e., transactional vs. transformational leadership) was examined across three specific indicators related to task execution: perceived adequacy of the time allocated, performance in building the LEGO figure, and actual time spent completing the task.

To examine the impact of leadership style on students' emotional climate during the cooperative task, both positive and negative emotional climate were assessed at three time points: at the beginning, during, and at the end of the LEGO activity. Non-parametric Mann-Whitney U tests were used to compare differences between leadership conditions at each time point (between-group analysis), while Wilcoxon signed-rank tests were applied to examine changes over time within each experimental condition (within-group analysis). Because multiple pairwise comparisons were conducted (3 time points $\times$ 6 emotions = 18 Wilcoxon signed-rank tests), a global Bonferroni correction was applied to control for Type I error inflation. The adjusted significance level was set at $\alpha = 0.0028$ ($0.05/18$). Effect sizes (r) were calculated for each Wilcoxon signed-rank test, values around 0.10 indicate small, around 0.30 medium, and ≥ 0.50 large effects (Cohen, 1988).

Finally, a qualitative content analysis was performed on the open-ended responses regarding the participants' experience with the task. An inductive open coding procedure was carried out with the support of ATLAS.ti (version 25), which facilitated the systematic organization, segmentation, and management of the data. Two researchers coded the data independently, allowing the assessment of intersubjective consistency. Intercooder reliability was calculated using Cohen's κ , which indicated substantial agreement ($\kappa = 0.82$). Discrepancies were resolved through discussion and consensus. Preliminary codes were subsequently refined and grouped into broader categories through a process of constant comparison, which were considered final once conceptual saturation was reached. Finally, the frequencies of the categories were calculated to estimate their relative weight and provide a quantitative complement to the qualitative analysis.

3 Results

3.1 Descriptive analyses and correlations

Before conducting inferential analyses, the assumption of normality was assessed for the study's main variables (i.e., emotional climate, performance, and time perception) using the

Kolmogorov-Smirnov and Shapiro-Wilk tests. In all cases, the results indicated significant deviations from normal distribution ($p < 0.05$), thereby justifying the use of non-parametric tests in subsequent analyses. Descriptive statistics (i.e., means and standard deviations) and Spearman correlations for each variable are presented in Table 1. Correlations above the diagonal correspond to the transformational leadership condition, and those below the diagonal correspond to the transactional leadership condition.

Under transformational leadership, the total emotional climate was strongly and positively correlated with the positive emotional climate ($\rho = 0.89, p < 0.001$) and moderately related to the negative emotional climate ($\rho = 0.41, p < 0.01$). As expected, positive and negative emotional climates were negatively associated ($\rho = -0.22, p < 0.05$). A higher positive emotional climate was also related to better task performance ($\rho = 0.26, p < 0.05$), while higher negative emotional climate was associated with poorer performance ($\rho = -0.47, p < 0.01$).

In the transactional leadership condition, a similarly strong positive correlation was found between total emotional climate and positive emotional climate ($\rho = 0.77, p < 0.001$), along with a weaker positive association with the negative emotional climate ($\rho = 0.30, p < 0.01$). As in the previous condition, positive and negative emotional climates were negatively related ($\rho = -0.36, p < 0.01$). Additionally, the negative emotional climate showed a small but significant inverse correlation with task performance ($\rho = -0.25, p = 0.02$), indicating that higher emotional negativity was related to slightly poorer performance outcomes.

Figure 1 displays the results regarding the accuracy of LEGO figure construction, revealing notable differences in group performance based on the type of leadership to which participants were exposed. Under the transformational leadership condition, 78.5% of teams achieved a perfect construction of the projected figure, 19% completed a partial construction, and only 2.5% failed to construct the figure.

In contrast, in the transactional leadership condition, no team achieved a perfect construction. The majority (69.2%) completed a partial construction, while 30.8% were unable to build the figure.

These findings suggest that transformational leadership positively influenced task performance by facilitating clearer understanding of the objective and enhancing team coordination toward a successful outcome.

Figure 2 shows the differences in perceived time availability during the task according to leadership style. In the transactional leadership condition, the vast majority of groups (98.9%) reported that they ran out of time to complete the task, only 1.1% indicated that the time was sufficient, and no group reported having extra time.

In contrast, under the transformational leadership condition, the results were more balanced: 31.6% of the groups stated they had extra time, 41.8% considered the time allocated was sufficient, and 26.6% reported they ran out of time to complete the task.

These results suggest that transactional leadership may foster a task organization more focused on temporal efficiency, whereas transformational leadership, by encouraging greater reflection, cooperation, and elaboration, could be associated with a greater perception of time pressure.

TABLE 1 Descriptive statistics and Spearman correlations by leadership condition ($N = 93$).

Items	Transformational M (SD)	Transactional M (SD)	(1)	(2)	(3)	(4)	(5)
1. Total emotional climate	2.12 (0.31)	2.06 (0.39)	(-)	0.89***	0.41**	0.03	-0.05
2. Positive emotional climate	2.82 (0.72)	2.77 (0.60)	0.77**	(-)	-0.22*	0.26*	-0.21
3. Negative emotional climate	1.29 (0.48)	1.47 (0.42)	0.30*	-0.36**	(-)	-0.47**	-0.09
4. Task performance	2.75 (0.48)	1.69 (0.46)	0.03	0.12	-0.25*	(-)	0.09
5. Perception of allocated time	2.10 (0.85)	1.99 (0.10)	0.10	0.17	-0.17	-0.07	(-)

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

M, Mean; SD, Standard Deviation; p , Spearman correlation. Correlations above the diagonal refer to the transformational condition; correlations below the diagonal refer to the transactional condition. Non-normality was assessed via Kolmogorov-Smirnov and Shapiro-Wilk tests (reported in the Methods), therefore non-parametric statistics were used.



FIGURE 1

LEGO figure construction accuracy by leadership style.

3.2 Between-group differences: comparison of emotional climate by leadership style

Table 2 presents the results of the non-parametric Mann-Whitney U tests comparing emotional climate across experimental conditions.

Regarding the positive emotional climate (i.e., happiness, surprise, and calm), the group under the transactional leadership condition reported significantly higher levels at the beginning of the task ($U = 2,666.50$, $p = 0.003$, $r = 0.30$), representing a medium

effect size, which indicates a slight initial advantage in positive emotions for this group. However, no significant differences were found between groups during the activity ($U = 3,507.50$, $p = 0.78$). By the end of the task, the transformational leadership group showed significantly higher levels of positive emotional climate ($U = 2,537.50$, $p < 0.001$, $r = 0.35$), also a medium effect, suggesting that this leadership style was more effective in sustaining and enhancing positive emotions over time.

When examining specific positive emotions, no significant differences were found in happiness at the beginning of the activity ($U = 3,177.50$, $p = 0.17$). During the task, however, participants

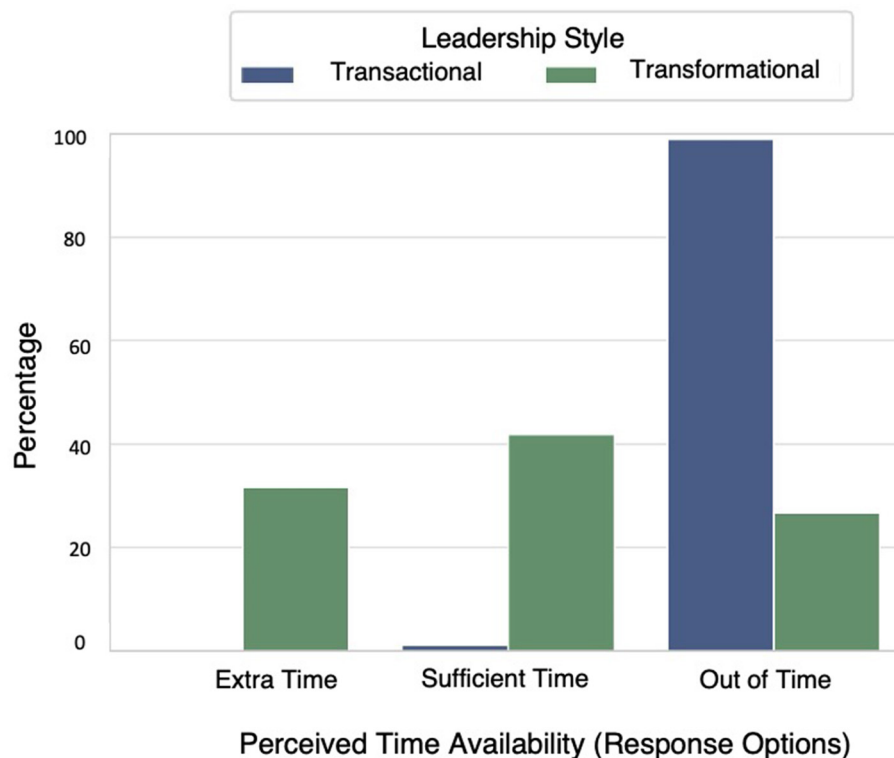


FIGURE 2
Perceived time availability during the task by leadership style.

exposed to transformational leadership reported higher levels of happiness ($U = 2,663.00$, $p = 0.003$, $r = 0.31$), and this pattern became even stronger by the end of the activity ($U = 2,222.50$, $p < 0.001$, $r = 0.46$). The effect sizes, medium during the task and large at the end, indicate that transformational leadership had an increasingly strong impact on happiness as the activity progressed.

For the emotion of surprise, significant differences were observed at the beginning of the activity ($U = 2,172.00$, $p < 0.001$, $r = 0.47$), with a large effect and higher levels in the transactional leadership group. However, no significant differences were found during the task ($U = 3,200.50$, $p = 0.20$), and only a marginal difference was observed at the end ($U = 2,918.50$, $p = 0.03$, $r = 0.23$), corresponding to a small effect, suggesting that the initial heightened surprise under transactional leadership gradually diminished over time.

In the case of calmness, no significant differences were observed between groups at any point in the experiment (T1: $U = 3,228.50$, $p = 0.23$; T2: $U = 3,439.00$, $p = 0.58$; T3: $U = 3,497.50$, $p = 0.73$), indicating comparable levels of emotional tranquility across leadership conditions.

In contrast, the negative emotional climate (i.e., sadness, anger, and fear) showed clear differences based on leadership style as the task progressed. At the beginning of the activity, no significant differences were observed between conditions ($U = 3,444.50$, $p = 0.58$). During the task, however, participants under transactional leadership reported significantly higher levels of negative emotional climate ($U = 2,247.50$, $p < 0.001$, $r = 0.46$), and this difference became even more pronounced by the end ($U = 2,195.00$, $p <$

0.001 , $r = 0.48$). In both cases, the large effect sizes indicate a substantial impact of transactional leadership on increased emotional distress, whereas transformational leadership acted as a protective factor against negative affect in cooperative contexts.

When analyzing specific negative emotions, no significant differences were found in sadness at the beginning ($U = 3,505.50$, $p = 0.64$) or during the task ($U = 3,290.00$, $p = 0.16$). By the end of the task, however, participants in the transactional group reported significantly higher levels of sadness ($U = 2,777.50$, $p = 0.002$, $r = 0.32$), representing a medium effect size, confirming the regulatory role of transformational leadership in mitigating this emotion toward the end of the experience.

For anger, no significant differences were observed at the beginning ($U = 3,446.50$, $p = 0.46$). However, significant differences emerged during and after the task, with lower anger levels reported under transformational leadership (during: $U = 2,293.00$, $p < 0.001$, $r = 0.46$; end: $U = 2,619.00$, $p < 0.001$, $r = 0.35$). The large effect during the task and medium effect at the end indicate that transformational leadership consistently reduced frustration and tension during cooperative work.

Finally, no significant differences were found in fear between conditions at any of the three time points (T1: $U = 3,446.50$, $p = 0.46$; T2: $U = 3,365.00$, $p = 0.21$; T3: $U = 3,588.50$, $p = 0.96$), indicating that this emotion remained stable and largely unaffected by leadership style throughout the activity.

As shown in Figure 3, the emotional climate evolved differently depending on the leadership style, with transformational leadership associated with more stable or improved positive

TABLE 2 Differences in emotional climate between leadership styles by time of evaluation (Mann–Whitney *U*; *N* = 93).

Variable and time of evaluation	Transformational leadership		Transactional leadership		Mann-Whitney <i>U</i>			
	M (SD)	Mean rank	M (SD)	Mean rank	<i>U</i>	<i>Z</i>	<i>P</i>	<i>r</i>
Positive climate T1	2.81 (0.75)	73.75	3.14 (0.67)	95.70	2,666.5	2.94	0.003	0.30
Positive climate T2	2.76 (0.77)	86.60	2.71 (0.71)	84.54	3,507.5	0.27	0.78	0.03
Positive climate T3	2.91 (0.88)	98.88	2.47 (0.77)	73.88	2,537.5	3.33	<0.001	0.35
Negative climate T1	1.26 (0.48)	83.59	1.28 (0.49)	87.16	3,444.5	0.54	0.58	0.06
Negative climate T2	1.29 (0.54)	68.54	1.57 (0.55)	100.30	2,247.5	4.44	<0.001	0.46
Negative climate T3	1.33 (0.65)	67.78	1.57 (0.51)	100.88	2,195.0	4.59	<0.001	0.48
Happiness T1	3.92 (1.24)	90.78	3.74 (1.23)	80.92	3,177.5	1.34	0.17	0.14
Happiness T2	3.95 (1.29)	97.29	3.48 (1.18)	75.26	2,663.0	3.02	0.003	0.31
Happiness T3	4.10 (1.26)	102.87	3.30 (1.26)	70.42	2,222.5	4.45	<0.001	0.46
Surprise T1	2.49 (1.37)	67.49	3.49 (1.03)	101.13	2,172.0	4.56	<0.001	0.47
Surprise T2	2.53 (1.41)	80.51	2.78 (1.25)	89.83	3,200.5	1.27	−0.20	0.13
Surprise T3	2.77 (1.53)	94.06	2.25 (1.35)	70.07	2,918.5	2.19	0.03	0.23
Calm T1	2 (1.36)	80.99	2.18 (1.27)	89.41	3,228.5	1.20	0.23	0.12
Calm T2	1.81 (1.25)	83.53	1.89 (1.21)	87.21	3,439.0	0.55	0.58	0.06
Calm T3	1.87 (1.36)	84.27	1.89 (1.25)	86.57	3,497.5	0.35	0.73	0.04
Sadness T1	1.20 (0.59)	84.37	1.25 (0.74)	86.48	3,505.0	0.46	0.64	0.05
Sadness T2	1.23 (0.61)	81.65	1.33 (0.70)	88.85	3,290.0	1.40	0.16	0.15
Sadness T3	1.32 (0.71)	75.16	1.63 (0.84)	94.48	2,777.5	3.08	0.002	0.32
Anger T1	1.23 (0.65)	83.63	1.23 (0.55)	87.13	3,446.5	0.73	0.46	0.08
Anger T2	1.48 (0.91)	69.09	2.11 (1.10)	99.80	2,293.0	4.45	<0.001	0.46
Anger T3	1.54 (1.05)	73.15	1.99 (1.11)	96.22	2,619.0	3.41	<0.001	0.35
Fear T1	1.23 (0.66)	83.63	1.23 (0.56)	87.13	3,446.5	0.74	0.46	0.08
Fear T2	1.18 (0.52)	82.59	1.29 (0.76)	88.02	3,365.0	1.25	0.21	0.13
Fear T3	1.14 (0.62)	85.42	1.11 (0.45)	85.57	3,588.5	0.04	0.96	0.00

T1 = before the task, T2 = during the task, and T3 = after the task. *Z* values are reported in absolute terms ($|Z|$).

emotions over time, and transactional leadership with a progressive decline.

In order to examine the evolution of the emotional climate based on the type of leadership (within-group analysis), non-parametric Wilcoxon tests were applied to compare the three time points of the LEGO task assessment (T1 = beginning, T2 = during, T3 = end) within each experimental condition (transformational leadership and transactional leadership). The corresponding results are presented in Table 3.

In the transformational leadership condition, the analysis of positive emotional climate revealed no significant variations between T1 and T2 ($Z = 1.04$, $p = 0.30$, $r = 0.11$) or between T1 and T3 ($Z = 1.42$, $p = 0.15$, $r = 0.15$). However, a marginally significant increase was observed between T2 and T3 ($Z = 2.37$, $p = 0.02$, $r = 0.25$), although this result did not remain significant after Bonferroni correction ($\alpha = 0.0028$). These findings indicate that the positive emotional climate remained stable at the beginning of the task and showed a slight upward trend toward the end, suggesting a potential emerging benefit of transformational leadership on students' positive emotional state. The overall magnitude of effects was small to moderate.

A more detailed analysis of individual positive emotions showed that happiness did not exhibit significant changes across the three time points (T1–T2: $Z = 0.60$, $p = 0.95$, $r = 0.05$; T1–T3: $Z = 1.45$, $p = 0.14$, $r = 0.15$). However, the change from T2 to T3 approached the threshold of significance ($Z = 1.76$, $p = 0.07$, $r = 0.18$). The pattern suggests a slight, non-significant upward tendency, with small effect sizes overall.

In contrast, surprise showed small to moderate increases throughout the task (T1–T3: $Z = 1.91$, $p = 0.05$, $r = 0.20$; T2–T3: $Z = 2.05$, $p = 0.04$, $r = 0.21$), indicating that the sense of novelty or engagement tended to rise over time, although this effect did not reach significance after Bonferroni adjustment.

Calmness increased significantly during the initial phase, from T1 to T2 ($Z = 2.82$, $p = 0.005$, $r = 0.29$), and then stabilized (T1–T3: $Z = 1.65$, $p = 0.09$, $r = 0.17$; T2–T3: $Z = 0.61$, $p = 0.54$, $r = 0.06$). Although this result did not surpass the Bonferroni threshold, the overall effects were moderate in magnitude, suggesting an early improvement in students' emotional self-regulation that was maintained throughout the activity.

Regarding the negative emotional climate, no significant differences were observed across any interval (T1–T2: $Z = 0.75$, p

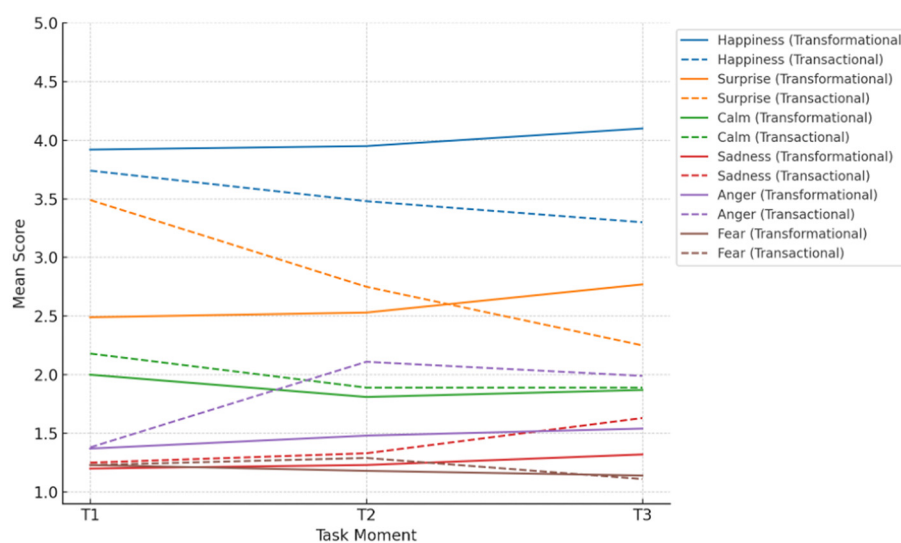


FIGURE 3

Evolution of emotional climate change during the task by leadership style. Scores are based on a 1–5 scale (1 = not at all, 5 = very much).

= 0.45, $r = 0.08$; T1–T3: $Z = 0.93$, $p = 0.35$, $r = 0.10$; T2–T3: $Z = 0.47$, $p = 0.63$, $r = 0.05$), indicating low and stable levels of negative affect throughout the task. Similarly, individual negative emotions (i.e., sadness, anger, and fear) showed no relevant variations, with small effect sizes ($r \leq 0.17$).

In contrast, under the transactional leadership condition, a progressive deterioration of the positive emotional climate was observed, with robust differences across all intervals: T1–T2 ($Z = 5.45$, $p < 0.001$, $r = 0.57$), T1–T3 ($Z = 6.35$, $p < 0.001$, $r = 0.66$), and T2–T3 ($Z = 3.11$, $p = 0.002$, $r = 0.32$). These results indicate a sustained and substantial decrease in positive emotions throughout the cooperative task, with effects ranging from medium to large in magnitude.

The analysis of individual positive emotions showed that happiness gradually declined over time (T1–T2: $Z = 2.80$, $p = 0.005$, $r = 0.29$; T1–T3: $Z = 3.10$, $p = 0.002$, $r = 0.32$; T2–T3: $Z = 1.89$, $p = 0.05$, $r = 0.20$). After Bonferroni correction ($\alpha = 0.0028$), only the difference between T1 and T3 remained significant. This pattern suggests a consistent but moderate decrease in happiness as the activity progressed.

Surprise also declined sharply across all intervals (T1–T2: $Z = 4.48$, $p < 0.001$, $r = 0.46$; T1–T3: $Z = 6.02$, $p < 0.001$, $r = 0.62$; T2–T3: $Z = 3.57$, $p < 0.001$, $r = 0.37$), showing medium-to-large effects overall and reflecting a pronounced loss of novelty and motivational engagement over time. Calmness decreased significantly from T1 to T2 ($Z = 2.75$, $p = 0.001$, $r = 0.29$) and from T1 to T3 ($Z = 2.54$, $p = 0.001$, $r = 0.26$), remaining stable thereafter (T2–T3: $Z = 0.09$, $p = 0.92$, $r = 0.01$). These findings point to an early reduction in emotional tranquility, of moderate magnitude, that was not recovered at the end of the task.

The negative emotional climate increased significantly from the beginning to the midpoint of the task ($Z = 4.92$, $p < 0.001$, $r = 0.51$) and from the beginning to the end ($Z = 4.65$, $p < 0.001$, $r = 0.48$), remaining stable during the final stage (T2–T3: $Z = 0.31$, $p = 0.75$, $r = 0.03$). The magnitude of these effects was medium to

large, indicating a strong initial escalation of emotional discomfort that plateaued toward the end. Among specific negative emotions, sadness increased significantly during the task (T1–T3: $Z = 3.33$, $p < 0.001$, $r = 0.35$; T2–T3: $Z = 2.83$, $p = 0.005$, $r = 0.29$), and anger also showed notable rises (T1–T2: $Z = 5.38$, $p < 0.001$, $r = 0.56$; T1–T3: $Z = 4.26$, $p < 0.001$, $r = 0.44$). These results reveal sustained medium-to-large increases in frustration and emotional tension throughout the activity. Finally, fear slightly decreased in the final stage (T2–T3: $Z = 2.31$, $p = 0.02$, $r = 0.24$), suggesting a small-to-moderate effect, possibly related to a mild adaptation or habituation process toward the end of the task.

3.3 Qualitative results on the LEGO-building experience according to leadership style

A thematic content analysis was conducted on the open-ended responses provided by participants regarding their experience during LEGO construction activities, carried out under two distinct experimental conditions (i.e., transformational leadership and transactional leadership).

With respect to the transformational leadership condition, seven categories were identified (see Table 4). The most frequent was *collaboration and group cohesion* (31.3%). Participants emphasized the importance of coordination, active participation, and equitable role distribution:

“Thanks to teamwork, we were able to reach our goals” (P12); “Each of us played a role during the activity” (P2).

This cohesion was perceived as key to collective success.

Positive emotional engagement (24.8%) was reflected in expressions of enjoyment, enthusiasm, and motivation:

TABLE 3 Within-group differences in emotional climate across three time points for each leadership condition (Wilcoxon signed-rank tests; $N = 93$).

Temporal comparison	Transformational leadership				Transactional leadership			
	Mean differences	Z	p	r	Mean differences	Z	p	r
Positive climate T1–T2	0.04	1.04	0.30	0.11	0.95	5.45	<0.001	0.57
Positive climate T1–T3	−0.11	1.415	0.15	0.15	0.66	6.35	<0.001	0.66
Positive climate T2–T3	−0.16	2.37	0.02	0.25	0.22	3.11	0.002	0.32
Negative climate T1–T2	−0.03	0.75	0.45	0.08	−0.29	4.92	<0.001	0.51
Negative climate T1–T3	−0.07	0.93	0.35	0.10	−0.29	4.65	<0.001	0.48
Negative climate T2–T3	−0.04	0.47	0.63	0.05	0.00	0.31	0.75	0.03
Happiness T1– T2	−0.03	0.06	0.95	0.01	0.26	2.80	0.005	0.29
Happiness T1–T3	−0.18	1.45	0.14	0.15	0.44	3.10	0.002	0.32
Happiness T2–T3	−0.15	1.76	0.07	0.18	0.18	1.89	0.05	0.20
Surprise T1–T2	−0.04	0.07	0.94	0.01	0.71	0.48	<0.001	0.46
Surprise T1–T3	−0.28	1.91	0.05	0.20	1.24	6.02	<0.001	0.62
Surprise T2–T3	−0.24	2.05	0.04	0.21	0.50	3.57	<0.001	0.37
Calm T1–T2	0.19	2.82	0.005	0.29	0.29	2.75	0.001	0.29
Calm T1–T3	0.13	1.65	0.09	0.17	0.29	2.54	0.001	0.26
Calm T2–T3	−0.06	0.61	0.54	0.06	0.00	0.09	0.92	0.01
Sadness T1–T2	−0.03	0.48	0.62	0.05	−0.08	1.14	0.25	0.12
Sadness T1–T3	−0.12	1.52	0.13	0.16	−0.38	3.33	<0.001	0.35
Sadness T2–T3	−0.09	1.17	0.24	0.12	−0.30	2.83	0.005	0.29
Anger T1–T2	−0.11	1.26	0.20	0.13	−0.73	5.38	<0.001	0.56
Anger T1–T3	−0.17	1.61	0.10	0.17	−0.61	4.26	<0.001	0.44
Anger T2–T3	−0.06	0.64	0.52	0.07	−0.12	1.31	0.19	0.14
Fear T1–T2	0.05	0.92	0.35	0.10	−0.06	0.85	0.39	0.09
Fear T1–T3	0.04	1.36	0.17	0.14	0.12	1.73	0.08	0.18
Fear T2–T3	0.09	0.71	0.47	0.07	0.18	2.31	0.02	0.24

Differences between T1 = before the task, T2 = during the task, and T3 = after the task. Z values are reported in absolute terms ($|Z|$). The direction of change (increase or decrease) is described in the text based on the mean differences. p -values were adjusted Bonferroni correction for multiple comparisons $\alpha = 0.0028$ (3 time points $\times$ 6 emotions = 18 Wilcoxon tests).

“Happy and motivated to do the activity” (P49); “Very fun, hands-on, and we worked together naturally” (P47). These responses suggest that both the activity and the transformational leadership style contributed to a safe and motivating emotional climate. The category <i>personal development and meaningful learning</i> (15%) highlighted the formative value of the experience: “It taught us the importance of teamwork” (P86); “Thanks to this experience, I got to know my teammates better” (P39); “The LEGO figure represents creativity and learning how to work as a team” (P24). <i>Task facilitation through structured guidance</i> (11.7%) included positive evaluations of having clear instructions:	“It was much easier with instructions” (P52); “We were guided with clear directives” (P86). Some responses included <i>reflective task comparisons</i> (9.7%), noting that while instructions facilitated task completion, they also reduced creativity: “The second activity was more effective, but we lost the chance to develop creativity and logical thinking” (P8). <i>Managed emotional tension</i> (8.4%) encompassed mentions of stress or frustration that were successfully overcome thanks to group coordination: “There were a few tense moments, but with everyone’s commitment, we achieved our goal” (P80).
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TABLE 4 Emergent categories of perceived experience during the task under transformational leadership.

Category	Description	Frequency (%)
Collaboration and group cohesion	References to effective teamwork, role distribution, mutual support, and group coordination.	31.3%
Positive emotional engagement	Expressions of enjoyment, motivation, enthusiasm, and emotional gratification during the task.	24.8%
Personal development and meaningful learning	Mentions of the activity as enriching, educational, or beneficial for interpersonal and personal growth.	15%
Task facilitation through structured guidance	Appreciation of clear instructions or guidelines that made the task easier and less frustrating.	11.7%
Reflective comparisons between tasks	Comments comparing this experience to previous tasks, highlighting differences in creativity, structure, or effectiveness.	9.7%
Managed emotional tension	Brief mentions of stress, pressure, or frustration that were resolved positively within the group dynamic.	8.4%

Illustrative participant quotes corresponding to each category are presented in the qualitative results narrative.

In contrast, under the transaccional leadership condition, eight categories were identified (see Table 5). The most prevalent was technical and organizational difficulty (22.7%), in which participants described the task as particularly complex, attributing this perception primarily to the absence of clear instructions. The lack of guidance generated a widespread sense of confusion and disorganization, as illustrated by the following responses:

“The experience was a bit complicated since we didn’t have any instructions” (P45); “It was difficult because we had no guide throughout the process” (P90).

Additionally, some participants noted the added challenge of not being able to visualize the internal structure of the figure, which limited their ability to plan effectively:

“We couldn’t figure out how the figure was built on the inside, and we couldn’t finish it” (P31).

Others reported that they were unable to identify or locate the necessary pieces, which reduced their level of engagement in the activity:

“I didn’t feel very useful because I couldn’t find the pieces to build my part” (P61).

These experiences reflect a lack of structural support, possibly exacerbated by a leadership style more focused on rule enforcement than on process facilitation.

TABLE 5 Emergent categories of perceived experience during the task under transactional leadership.

Category	Description	Frequency (%)
Technical and organizational difficulty	Comments about lack of instructions, confusion, or technical complexity.	22.7%
Frustration	Expressions of helplessness, anger, or emotional blockage due to task difficulty.	19.1%
Enjoyment	Positive appraisals related to fun, entertainment, or enthusiasm	16.4%
Valuing cooperation	Recognition of teamwork as a valuable or effective component.	12.5%
Stress	Mentions of nervousness caused by time pressure, task complexity, lack of instructions, and inadequate group coordination.	11.8%
Satisfaction	Feelings of accomplishment, pride, or gratification with the process or outcome	9.2%
Unequal participation	Observations about uneven task distribution or exclusion in group dynamics.	4.4%
Personal growth	Narratives of learning or overcoming difficulties.	3.9%

Illustrative participant quotes corresponding to each category are presented in the qualitative results narrative.

The second most frequent category was *frustration* (19.1%), expressed through feelings of helplessness, emotional blockage, and dissatisfaction with personal performance:

“It was frustrating” (P22); “I thought I’d really enjoy it and ended up super frustrated” (P26).

In many cases, frustration accumulated progressively, resulting from unmet expectations of enjoyment:

“It was fun, but also frustrating not to be able to finish the figure on time” (P73).

Loss of control over the task was also reported as a contributing factor:

“It’s a bit frustrating, I get frustrated when I’m not in control of everything” (P48).

The category *enjoyment* (16.4%) indicated that, despite the challenges, many participants perceived the activity as positive, creative, and playful:

“Very exciting and fun” (P6); “A fun experience with my teammates” (P79).

However, some responses reflected ambivalent emotions, where enjoyment was mixed with discomfort:

“Fun, but also stressful because I couldn’t figure it out” (P49).

In the category *recognition of cooperation* (12.5%), participants acknowledged teamwork as essential to task completion:

“A good way to work as a team to achieve a common goal” (P44).

Some responses highlighted the need to synchronize individual efforts in the absence of external guidance:

“Working as a team is more effective, as everyone contributes their knowledge” (P48).

Stress (11.8%) was primarily linked to time pressure, task complexity, and lack of instructions or coordination:

“Stressful due to limited time” (P37); “Even more stressful without instructions, with little group coordination” (P88).

At times, stress was coupled with frustration:

“A frustrating and stressful experience from the start” (P63).

Satisfaction (9.2%) appeared in positive evaluations of the experience, even if the final goal was not achieved:

“I loved working with LEGOs” (P72); “A very rewarding experience” (P37).

Some responses indicated a blend of enjoyment and partial frustration:

“I liked the activity, but I felt frustrated for not finishing my part” (P23).

Unequal participation (4.4%) reflected experiences of exclusion:

“I couldn’t participate, some teammates took over the whole activity” (P64).

This suggests that an uneven distribution of roles may have negatively impacted emotional involvement and self-efficacy.

Lastly, *learning and personal growth* (3.9%) included narratives of improvement, skill discovery, or changes in expectations:

“Better than expected at first” (P53); “Something impossible can become possible with help” (P7).

3.4 Integrated quantitative and qualitative findings

Finally, the qualitative evidence complements and contextualizes the quantitative findings, offering a more comprehensive understanding of how leadership styles shaped students’ emotional climate during the LEGO tasks. Quantitative

analyses indicated that leadership style significantly affected both the positive and negative dimensions of emotional climate (Tables 2, 3). Under transformational leadership, participants exhibited a gradual enhancement of positive emotional climate toward the end of the activity and maintained consistently low levels of negative affect. In contrast, transactional leadership was associated with a marked decline in positive emotions and a concurrent increase in negative ones.

These statistical patterns were mirrored in the qualitative data. Within the transformational condition, the most prevalent categories were collaboration and group cohesion and positive emotional engagement (Table 4). Participants described teamwork, mutual support, and shared motivation [e.g., “Thanks to teamwork, we were able to reach our goals”, (P12)], which aligned with the sustained positive emotional tone and increases in happiness and calm identified quantitatively. Mentions of structured guidance and managed emotional tension further supported the stability of affective regulation observed in the statistical analyses, suggesting that transformational leadership promoted both emotional balance and collective efficacy during the cooperative process.

Conversely, in the transactional leadership condition, the dominant qualitative categories, technical and organizational difficulty, frustration, and stress (Table 5), closely reflected the higher levels of negative emotional climate and the elevation of specific negative emotions such as sadness and anger. Narratives of confusion, pressure, and emotional overload [e.g., “It was frustrating because we didn’t have any instructions”, (P45)] help explain the deterioration of affective experience under this leadership style. Although some participants mentioned enjoyment or recognition of cooperation, these appeared alongside reports of tension and disorganization, indicating that positive emotions were fragile and often undermined by the task’s structural challenges.

Taken together, the integration of quantitative and qualitative evidence reveals that transformational leadership fosters a cohesive, emotionally regulated, and motivating group atmosphere, whereas transactional leadership amplifies emotional strain and disorganization, resulting in a more negative emotional climate and lower affective engagement. This convergence highlights the emotional mechanisms through which leadership influences cooperative learning experiences.

4 Discussion

The present study aimed to examine the differential impact of two leadership styles (i.e., transformational and transactional) on emotional climate, performance in a cooperative task, and time perception, as well as to track the evolution of emotional climate during a group activity involving collaborative LEGO block construction.

Between-group analyses provide empirical support that partially confirms Hypothesis 1. Specifically, students in the transformational leadership condition reported significantly higher levels of positive emotional climate at task completion, along with lower levels of negative emotional climate during and at the end of the activity. This pattern suggests that transformational leadership not only promotes emotional stability but also fosters a

progressive enhancement of group affective wellbeing, creating a psychologically safe and motivating environment. These findings align with earlier research emphasizing this leadership style's capacity to cultivate cooperative, positive, and resilient climates in educational settings (Bass and Riggio, 2006; Leithwood and Jantzi, 2005; Wang and Howell, 2010).

Furthermore, consistent with Avolio et al. (2009), transformational leadership, which encourages inspiration, intellectual stimulation, and emotional support, appears to facilitate sustained increases in positive emotions such as joy and surprise, while concurrently contributing to a reduction in negative emotions like fear and sadness, particularly toward the end of the task.

It is worth noting that at the outset, the transactional leadership group reported higher levels of positive emotional climate, especially surprise, likely reflecting a novelty effect as this was the first condition administered. However, this initial advantage was reversed as the activity progressed, illustrating the cumulative and stabilizing effect of transformational leadership on emotional wellbeing. Additionally, a gradual reduction in negative emotions was observed within this condition, possibly linked to collective achievement and a shared sense of competence fostered by a cooperative, empowerment-oriented leadership style.

In contrast, findings under the transactional leadership condition partially support Hypothesis 2. Although this group initially exhibited moderately high levels of positive emotional climate, these levels declined significantly over time, while negative emotions, particularly anger and sadness, increased steadily through task completion. This emotional deterioration corroborates studies associating transactional leadership with rigid environments characterized by low affectivity and emotional unsustainability (Leithwood and Jantzi, 2008).

Qualitative data further support this interpretation. Students in the transactional condition repeatedly expressed frustration, stress, anger, and disorientation, frequently citing lack of instructional clarity and insufficient emotional support from leadership. These outcomes echo Sheena et al. (2025), who found that transactional leaders, while offering operational structure and control, often lack the relational and emotional capacities needed to sustain positive emotional climates in demanding or ambiguous situations.

The within-group results (i.e., within each leadership condition) revealed a differentiated emotional evolution between the two leadership styles. Under transformational leadership, the emotional climate remained relatively stable and positive throughout the task, with a tendency to increase toward the end, thereby supporting Hypothesis 1. Moreover, the stability of the negative climate indicates an effective emotional regulation, characteristic of cohesive teams guided by a facilitative leadership style.

In contrast, under transactional leadership, the positive climate significantly decreased from the beginning to the end of the task, whereas the negative climate increased during the task and remained high until its completion. This decline in affective wellbeing, accompanied by the intensification of unpleasant emotions, reflects a lower capacity for emotional regulation and collective adaptation, consistent with more hierarchical and control-oriented environments. These results support previous

research linking transactional leadership with low emotional sustainability and higher group stress (Harms et al., 2017), thereby reinforcing Hypothesis 2.

Furthermore, the results confirm Hypothesis 3, showing that a positive emotional climate enhances performance and the perception of available time. In the transformational condition, characterized by predominantly positive emotions, most teams (78.5%) completed the LEGO figure perfectly, and 68% considered that the time allocated was sufficient. In contrast, in the transactional condition, associated with a more negative emotional climate, no team achieved a perfect construction; the majority (69.2%) produced only a partial build, and 98.9% reported insufficient time to complete the task.

These findings suggest that subjective time perception and task accuracy largely depend on the group's emotional state, as proposed by emotional contagion models in collaborative contexts (Barsade and Gibson, 2012). In this regard, research has shown that leaders influence both the individual mood of team members and the group's affective tone, which in turn impacts team performance (Volmer, 2012). In line with Camacho-Marín et al. (2024), transformational leaders provide socioemotional support to help the group achieve its goals and foster cohesion, leading to more effective and sustained performance.

Qualitative findings further illuminate distinctions between conditions. Under transformational leadership, participants reported fluid cooperation, active engagement, and positive emotion regulation, whereas under transactional leadership, narratives of blockage, disorganization, and emotional distress prevailed (e.g., stress, discomfort). Some participants also offered valuable metacognitive reflections comparing the two tasks. They observed that while transformational leadership provided structured execution, it also limited creativity and logical reasoning. In contrast, transactional leadership, although more frustrating, allowed greater creative freedom. This tension between efficiency and creativity has also been documented by Sawyer (2012), who warned that excessive structure can hinder divergent thinking, which is essential in innovation-oriented educational contexts. In this regard, the positive impact of transformational leadership depends on contextual conditions that promote autonomy, active participation, and the creative engagement of organizational members. Recent research confirms that transformational leadership fosters innovation only when organizations possess a strong capacity for innovation (Waqas et al., 2024), indicating that its creative effect weakens in environments with low autonomy or limited resources (Maitlo et al., 2022; Zhang et al., 2020). In line with Sheena et al. (2025), the literature suggests that a flexible and hybrid leadership approach may be the most effective in complex educational contexts, as it combines the structure necessary for execution with the flexibility that encourages creativity and innovation.

4.1 Theoretical and practical implications

The findings of this study provide important theoretical and practical implications for the design and facilitation of cooperative learning tasks in educational contexts. Promoting

transformational leadership among teachers appears to enhance the classroom's emotional climate, strengthen students' sense of belonging, foster group engagement, and improve academic performance (Day et al., 2016; Hosseingholizadeh et al., 2020). Therefore, incorporating the development of transformational leadership within both pre-service teacher education and continuous professional development programs is essential for cultivating emotionally supportive and pedagogically sustainable learning environments. In this regard, collaborative tasks using LEGO-based methodologies represent powerful tools for practicing and observing leadership behaviors, emotional regulation, and team coordination in action.

Furthermore, structuring cooperative tasks that balance clear organizational guidance with student autonomy can enhance both process effectiveness and creative self-efficacy (Jonassen, 1999). This balance is particularly important, as excessive control may inhibit initiative and active participation, whereas excessive freedom may result in dispersion or lack of focus. In this sense, promoting cooperative learning experiences that combine structured direction with genuine spaces for exploration and shared decision-making helps foster a positive emotional climate, intrinsic motivation, and shared responsibility for learning outcomes.

In addition, the integration of complementary leadership styles may offer significant advantages in contexts characterized by overlapping social, economic, and political challenges, allowing for more flexible, inclusive, and resilient educational responses (Du Plessis and Keyter, 2020). These authors use the term complementary leadership to describe the strategic combination of different leadership approaches, such as transformational, transactional, or distributed leadership, applied flexibly according to contextual needs. From this perspective, leadership styles are not mutually exclusive but rather mutually reinforcing, leveraging the strengths of each to compensate for their limitations.

For instance, while transformational leadership promotes vision, motivation, and innovation, transactional leadership provides the structure, norms, and coordination mechanisms necessary to ensure organizational effectiveness. Likewise, distributed or participative leadership strengthens collaboration and shared responsibility among teaching staff. Integrating these styles in a complementary way enables educational leaders to maintain institutional stability and clarity of objectives without sacrificing teacher creativity, autonomy, or emotional engagement.

In this regard, Priny (2014) also highlights that many schools fail to reach their full potential due to the lack of articulation between different leadership styles (e.g., transformational and transactional). Her integrated leadership school model proposes that effective leadership combines structured direction with collaborative participation, fostering environments where strategic planning and pedagogical innovation coexist productively.

Taken together, these implications underscore the need to promote integrated and adaptive educational leadership approaches that not only foster collaboration and emotional wellbeing but also strengthen adaptability, creativity, and innovation in response to the complex systemic demands of contemporary education.

4.2 Limitations and future research

This study presents several limitations that should be considered when interpreting the findings. First, the sample consisted of a limited number of participants from a single educational context, university students from one institution, which restricts the generalizability of the results to other educational levels and settings. The high proportion of female participants reflects the typical composition of teacher education programs in Spain, providing ecological validity to the sample. Although all participants came from the same university, this ensured cultural and institutional homogeneity, which was advantageous for maintaining experimental control. Nevertheless, the generalization of the findings should be interpreted with caution, and future studies are encouraged to replicate the design in more diverse contexts (e.g., different educational levels, organizations, cultures, or with greater gender diversity).

Second, although the fixed order of leadership conditions was methodologically justified, it may have introduced emotional carryover effects between conditions. Participants' emotional responses or engagement during the second (i.e., transformational) task could have been influenced by their prior experience in the transactional condition. To minimize potential sequence-related biases, future research should consider counterbalancing the order of conditions, increasing the temporal interval between tasks, or assessing participants' emotional baselines prior to each condition.

Third, self-report questionnaires present inherent limitations arising from the tendency to respond in socially desirable ways or from biases related to the subjective interpretation of processes, such as participants' perceptions of their own performance. To mitigate these limitations, task performance was evaluated through a dual-check procedure (i.e., combining participants' self-reports with researchers' real-time observations) in order to enhance objectivity and consistency. In both cases, this assessment was based on a single item evaluating three performance levels (i.e., complete, partial, or incomplete construction). Future studies could benefit from incorporating more detailed observer-based evaluations, such as multi-item performance rubrics assessing a broader range of aspects or video analyses of group interactions, which would allow for more precise insights into task execution and collaborative dynamics. The integration of such complementary methods would strengthen both the reliability and validity of performance assessments in cooperative learning contexts.

Furthermore, the use of single-item measures to assess task performance and time perception may have reduced measurement reliability. However, since these constructs were specific, narrow, and directly observable, the use of single-item indicators was considered methodologically appropriate in this context (Allen et al., 2022). Even so, future research could employ multi-item scales to increase measurement precision and allow for more robust reliability analyses.

Fourth, the assessment of emotional climate through self-reports may have been influenced by social desirability biases or individual differences in emotional expression. To advance the understanding of group affective processes, it would be advisable to complement self-reports with physiological or behavioral indicators of emotion, such as heart rate, facial expression, or voice

tone, to obtain a richer and more objective understanding of group emotional dynamics.

In addition, future research should expand samples to include participants from different educational levels, sociocultural contexts, and with greater gender diversity, in order to strengthen the external validity of the findings. From a methodological perspective, future studies could examine the mediating role of emotional climate between leadership style and group performance, as well as evaluate the impact of transformational leadership on other relevant outcomes, such as self-efficacy, deep learning, and group cohesion.

Finally, although this study focused on transformational and transactional leadership, it would be valuable for future research to explore hybrid or distributed leadership approaches, which could provide a more nuanced and valid understanding of how different leadership strategies are combined in real collaborative contexts. Likewise, future studies could employ longitudinal designs to better understand how leadership behaviors evolve over time and how they influence the sustainability of group performance and emotional climate. Furthermore, incorporating experimental settings that use construction block activities (e.g., LEGO) or other interactive simulations could offer a methodologically valid means of observing leadership processes as they emerge, enabling researchers to link behavioral indicators, affective dynamics, and performance outcomes within authentic group interactions.

4.3 Conclusions

The present study examined the differential effects of transformational and transactional leadership styles on emotional climate, performance in a cooperative task, and time perception, as well as the evolution of emotional climate throughout a collaborative LEGO-based activity in a university educational context.

The results, obtained through a mixed-methods approach, provide a robust understanding of the regulatory role played by different leadership styles in shaping group emotional dynamics and the effectiveness of structured cooperative experiences. Overall, the findings demonstrate that transformational leadership is associated with greater emotional stability and a progressive increase in positive emotional climate throughout the task, along with a sustained reduction in negative emotions. This leadership style fostered working environments marked by greater emotional engagement, efficient coordination, positive perception of available time, and improved task performance.

In contrast, transactional leadership exhibited the opposite pattern, a gradual decline in positive emotional climate and an increase in frustration, stress, and emotional discomfort, especially toward the end of the activity. These results suggest that a leadership approach focused exclusively on rule enforcement and behavioral supervision may undermine the emotional quality of group interactions, negatively affecting both the experience and the outcomes of the task.

In this regard, the data underscore the pedagogical value of transformational leadership as a key tool for fostering emotionally

safe, motivating, and cohesive climates that support both individual wellbeing and collective effectiveness. Furthermore, the findings highlight that cooperative tasks require not only structural organization but also emotional support, a sense of belonging, and a culture of mutual support to reach their full educational potential.

Finally, this study contributes to the educational leadership literature by empirically demonstrating, through methodological triangulation, how leadership styles influence not only academic performance but also the emotional experiences of students. Promoting transformational leadership practices in educational settings may represent a strategic pathway for enhancing both group effectiveness and students' socio-emotional wellbeing.

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 authors.

Ethics statement

The studies involving humans were approved by Research Ethics Committee of the Faculty of Education Sciences, Universitat (Spain). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

MV: Funding acquisition, Writing – review & editing, Validation, Methodology, Formal analysis, Supervision, Investigation, Data curation, Writing – original draft, Project administration, Resources, Conceptualization. NV-C: Methodology, Data curation, Visualization, Investigation, Project administration, Conceptualization, Validation, Supervision, Formal analysis, Writing – review & editing, Writing – original draft.

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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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