Journal Website

Article history:
Received 01 February 2026
Revised 01 June 2026
Accepted 07 June 2026
Initial Published 20 June 2026
Final Publication 01 September 2026

Iranian Journal of Neurodevelopmental Disorders

Volume 5, Issue 5, pp 1-11

Journal of Neurodevelopmental Disorder

E-ISSN: 2980-9681

Structural Equation Modeling of the Relationship Between Self-Regulated Learning and Academic Boredom in Mathematics: The Mediating Role of Academic Emotions Among Female High School Students in Tehran

Elham. Nikookar[1], Noorali. Farrokhi[2*], Fariborz. Dortaj[3], Fatemeh. Ghaemi [4]

[1] Ph.D. student, Department of Educational Psychology, SR.C., Islamic Azad University, Tehran, Iran
[2] Associate Professor, Department of Measurement and Assessment, Allameh Tabataba'i University, Tehran, Iran
[3] Professor, Department of Educational Psychology, Allameh Tabataba'i University, Tehran, Iran
[4] Associate Professor of Endocrinology, Vice Chancellery for Treatment, Ministry of Health and Medical Education, Tehran, Iran

*** Corresponding author email address**: farrokhi@atu.ac.ir

A r t i c l e I n f o

Article type:
Original Research

How to cite this article:
Nikookar, E., Farrokhi, N., Dortaj, F., & Ghaemi, F. (2026). Structural Equation Modeling of the Relationship Between Self-Regulated Learning and Academic Boredom in Mathematics: The Mediating Role of Academic Emotions Among Female High School Students in Tehran. *Iranian Journal of Neurodevelopmental Disorders, 5*(5), 1-11.
https://doi.org/10.61838/kman.jndd.856

A B S T R A C T

Purpose: The present study aimed to investigate the structural equation model of the relationship between self-regulated learning and academic boredom in mathematics, with academic emotions as a mediating variable, among female upper-secondary school students in Tehran.

Methods and Materials: This applied study was conducted using a descriptive-correlational design based on structural equation modeling. The statistical population consisted of all female upper-secondary school students in Tehran during the 2023–2024 academic year. Based on the recommended criteria for structural equation modeling, 375 students were selected through convenience sampling. Data were collected using the Academic Boredom Scale developed by Pekrun et al. (2002), the Self-Regulated Learning Questionnaire developed by Bouffard et al. (1995), and the Achievement Emotions Questionnaire developed by Pekrun et al. (2002). The data were analyzed using descriptive statistics, Pearson's correlation coefficient, and structural equation modeling in SPSS version 24 and LISREL version 8.5.

Findings: The results indicated that the proposed model had a good fit. In addition, self-regulated learning had a direct, negative, and significant effect on academic boredom in mathematics (β=-0.61, $p<0.001$). Furthermore, self-regulated learning was positively and significantly related to academic emotions (β=0.11, $p<0.01$), and academic emotions had a negative and significant effect on academic boredom (β=-0.21, $p<0.001$). The results of the Sobel test also confirmed the significance of the indirect effect of self-regulated learning on academic boredom through academic emotions (Z=3.42, $p<0.001$). Overall, the findings showed that self-regulated learning contributes to reducing academic boredom in mathematics both directly and indirectly through enhancing positive academic emotions.

Conclusion: Therefore, simultaneous attention to the cognitive and emotional dimensions of learning—particularly through teaching self-regulation strategies and improving the emotional quality of the classroom environment—may help reduce academic boredom and improve students' experience of learning mathematics.

Keywords: *Academic boredom, Academic emotions, Female upper-secondary school students, Mathematics, Self-regulated learning, Structural equation modeling*

1. Introduction

Academic success in contemporary educational systems is shaped not only by students' cognitive abilities but also by a complex interaction of motivational, emotional, and self-regulatory processes. Within this framework, mathematics occupies a particularly important position because it serves as a foundational subject for scientific literacy, higher education opportunities, and future career pathways. Despite its importance, mathematics is frequently associated with adverse psychological experiences, including anxiety, frustration, disengagement, and boredom. Research has consistently shown that many students perceive mathematics as a difficult and emotionally demanding subject, leading to diminished interest and reduced participation in learning activities (Ashcraft & Moore, 2021). Educational reform initiatives have therefore emphasized the need to create learning environments that foster positive engagement and meaningful participation in mathematics learning (National Council of Teachers of, 2022). Furthermore, international educational reports have highlighted that students' emotional experiences at school substantially influence their academic engagement, motivation, well-being, and achievement outcomes (Oecd, 2020). Consequently, understanding the factors that contribute to students' emotional experiences in mathematics has become a major concern for educational researchers and practitioners.

Among the various emotional experiences encountered by students, academic boredom has emerged as one of the most prevalent and detrimental emotions in educational settings. Academic boredom is generally characterized by feelings of dissatisfaction, lack of stimulation, reduced attention, low perceived value of learning activities, and a desire to withdraw from the academic task. Unlike transient moments of disinterest, academic boredom represents a sustained emotional state that can interfere with learning processes and educational development (Westgate & Wilson, 2018). Recent systematic reviews indicate that boredom is a multidimensional construct associated with both environmental and personal factors, including classroom characteristics, instructional methods, cognitive appraisals, and individual motivational processes (Ren et al., 2023). In mathematics education specifically, boredom has attracted increasing attention because of its strong association with avoidance behaviors, reduced effort, diminished persistence, and lower academic achievement (Ahmadi & Yousefipour, 2020; Habibi & Mansournia, 2018). Studies have further demonstrated that students who frequently experience boredom are more likely to disengage from learning activities and develop negative attitudes toward academic tasks (Tze et al., 2016). As a result, boredom is now recognized as a significant threat to educational success and student well-being.

The growing importance of academic boredom is also reflected in recent empirical investigations examining its antecedents and consequences. Research has shown that boredom negatively affects academic performance, motivation, engagement, and psychological well-being (Bekker & Rothmann, 2023). Students who experience chronic boredom often report lower levels of concentration, weaker academic commitment, and increased tendencies toward procrastination and withdrawal from challenging tasks (Putwain et al., 2021). In addition, boredom has been linked to maladaptive achievement patterns and unfavorable educational outcomes across different educational contexts (Krannich et al., 2019). Recent studies conducted among university students have identified numerous factors contributing to academic boredom, including inadequate challenge, lack of relevance, poor instructional practices, and insufficient emotional engagement with learning activities (Phan et al., 2024). Given these findings, identifying psychological mechanisms that can reduce boredom has become an important priority in educational psychology.

One of the most influential constructs proposed to explain successful learning and adaptation in academic settings is self-regulated learning. Self-regulated learning refers to learners' active participation in their own learning processes through goal setting, strategic planning, self-monitoring, self-evaluation, and behavioral regulation. Rather than being passive recipients of information, self-regulated learners actively manage their cognition, motivation, behavior, and learning environment in pursuit of academic goals (Hadwin et al., 2020; Schunk, 2023). Theoretical and empirical literature consistently emphasizes that self-regulation contributes significantly to academic achievement, persistence, and adaptive learning outcomes. Students with stronger self-regulatory skills are better equipped to cope with academic challenges, maintain motivation, and sustain engagement during demanding learning tasks (Tabatabaei & Ghaderi, 2018). Meta-analytic evidence has also demonstrated robust positive relationships between self-regulated learning strategies and academic achievement across diverse educational contexts (Tavakoli, 2016). Furthermore, factors promoting self-regulation have been

E-ISSN: 2980-9681

shown to play a crucial role in students' educational development and long-term academic success (Zeighamian & Moeinikia, 2019).

The potential relationship between self-regulated learning and academic boredom is theoretically compelling. Students who possess effective self-regulatory skills are generally more capable of maintaining attention, managing learning difficulties, and finding personal meaning in academic activities. These competencies may protect them from experiencing boredom by increasing task engagement and promoting a sense of control over learning situations. Conversely, students with poor self-regulation may struggle to manage academic demands, resulting in disengagement and heightened susceptibility to boredom. Empirical findings support this assumption, suggesting that self-regulated learners are less likely to experience negative academic emotions and more likely to remain actively engaged in learning tasks (Hosseini-Manesh, 2019). The relationship is particularly relevant in mathematics, where sustained cognitive effort and strategic problem-solving are essential components of successful learning.

Although self-regulated learning provides an important explanatory framework, recent theoretical developments suggest that emotional processes play a central role in determining educational outcomes. Educational psychologists increasingly recognize that emotions are not merely byproducts of learning but fundamental components of cognitive and motivational functioning (Pekrun et al., 2022). According to contemporary theories of achievement emotions, students' emotional experiences influence attention, memory, information processing, motivation, and self-regulation. Positive emotions such as enjoyment, pride, and hope tend to facilitate learning, whereas negative emotions such as anxiety, frustration, and boredom often undermine academic performance (Pekrun, 2022). Consequently, understanding students' emotional experiences has become essential for explaining educational success and failure.

Among the most influential theoretical frameworks in this area is Pekrun's Control-Value Theory of Achievement Emotions. This theory proposes that academic emotions arise from students' perceptions of control over learning activities and the subjective value they assign to academic tasks. When students perceive high levels of control and value, positive emotions are more likely to emerge; when these perceptions are low, negative emotions become more prevalent (Pekrun et al., 2022). Achievement emotions subsequently influence motivation, cognitive engagement, learning strategies, and performance outcomes. Therefore, academic emotions serve both as outcomes of educational experiences and as mechanisms through which other psychological factors affect academic functioning (Pekrun, 2022). This perspective suggests that academic emotions may play a critical mediating role in the relationship between self-regulated learning and academic boredom.

A growing body of research supports the importance of academic emotions in educational contexts. Meta-analytic findings have demonstrated strong associations between achievement emotions and academic performance, indicating that emotional experiences significantly influence students' educational outcomes (Camacho-Morles et al., 2021). Similarly, systematic reviews have confirmed that positive academic emotions contribute to higher achievement, whereas negative emotions are associated with poorer academic outcomes (Liu et al., 2023). Educational scholars have further emphasized that emotions are integral components of successful learning and should be considered alongside cognitive and motivational variables (Ge, 2021). Recent person-centered investigations have also shown that emotional regulation, academic motivation, and academic emotions jointly influence students' approaches to learning and educational adjustment (Rentzios et al., 2025).

Recent evidence has further demonstrated the growing significance of negative academic emotions in contemporary educational environments. Studies utilizing advanced predictive modeling techniques have shown that negative academic emotions can be accurately predicted through combinations of academic, psychological, and contextual variables, highlighting their central role in educational functioning (Ma et al., 2025). Similarly, investigations into adolescent behavior have revealed that negative emotions contribute to maladaptive outcomes and that self-control mechanisms can significantly influence these relationships (Kim et al., 2025). In educational settings, stress-related emotional experiences have been linked to procrastination and reduced academic functioning, with emotional processes serving as critical mediators between stressors and educational outcomes (Cao et al., 2025). These findings collectively underscore the importance of examining emotional mechanisms when investigating academic behaviors and experiences.

Research has also highlighted the close relationship between learning strategies and academic emotions. Students who employ effective learning strategies tend to experience more positive emotional states and greater satisfaction with their learning experiences (Wu et al., 2021).

E-ISSN: 2980-9681

Likewise, studies examining educational environments have found that academic emotions mediate the effects of instructional and motivational variables on academic competence and achievement (Mousavi et al., 2017). Goal orientation has similarly been identified as an important factor influencing both boredom and academic achievement, suggesting that motivational and emotional processes operate together in shaping students' educational experiences (Mavrou, 2023). These findings provide additional support for investigating academic emotions as a mediator between self-regulated learning and academic boredom.

Despite the substantial literature on self-regulated learning, academic emotions, and boredom, several gaps remain. First, many studies have examined these variables independently rather than within an integrated structural framework. Second, although boredom has received increasing attention in recent years, fewer studies have specifically focused on boredom in mathematics compared to other achievement emotions. Third, research investigating the mediating role of academic emotions in the relationship between self-regulated learning and academic boredom remains limited, particularly among high school students. Finally, educational and cultural contexts may influence how students experience emotions and regulate their learning, necessitating context-specific investigations. Addressing these gaps is important for developing comprehensive theoretical models capable of explaining students' learning experiences in mathematics.

Female high school students represent a particularly important population for such investigations. During adolescence, students encounter increasing academic demands, heightened performance expectations, and significant educational transitions. These developmental and educational challenges can intensify emotional experiences and place greater demands on self-regulatory capacities. Understanding how self-regulated learning and academic emotions contribute to boredom among female students may therefore provide valuable insights for educational interventions aimed at promoting engagement, emotional well-being, and academic success. Moreover, identifying modifiable psychological factors associated with boredom can inform the design of prevention and intervention programs within school settings.

Therefore, the present study aimed to investigate the structural equation model of the relationship between self-regulated learning and academic boredom in mathematics, with academic emotions serving as a mediating variable, among female high school students in Tehran.

2. Methods and Materials

2.1. Study Design and Participants

The present study was an applied research project conducted using a descriptive-correlational design based on Structural Equation Modeling (SEM). The statistical population consisted of all female students enrolled in the second cycle of secondary education in Tehran during the 2023–2024 academic year. Based on the recommendations of Stevens (1994, as cited in Houman, 2023) and Hair et al. (2008), who suggested a minimum sample size of 15 participants per observed variable to obtain stable estimates and an adequate model fit, a sample of 375 female students was selected through convenience sampling. To compensate for potential sample attrition and to enhance the accuracy of the analyses, the final analysis was conducted using this sample size.

The inclusion criteria were being a female student, being enrolled in the second cycle of secondary education, residing in Tehran, and providing informed consent to participate in the study. The exclusion criteria included incomplete questionnaire responses, careless responding, and a self-reported history of severe physical or psychological disorders that could affect the student's academic performance.

After obtaining the necessary permissions from the relevant educational authorities in Tehran, the data collection process was carried out from April 14 to May 19, 2024. Prior to the implementation of the study, the objectives of the research were explained to the students, and the voluntary nature of participation was emphasized. Informed consent was obtained from all participants, and they were assured that their information would remain confidential and that their responses would be analyzed anonymously. The questionnaires were distributed in the classroom setting and were collected by the researcher after completion.

2.2. Measures

1. Academic Boredom Scale: This scale was developed by Pekrun et al. (2002) and consists of 22 items designed to assess students' level of boredom in educational and learning situations. The instrument includes two subscales: Class-Related Boredom and Learning-Related Boredom. The items are rated on a 5-point Likert scale ranging from 1 =

E-ISSN: 2980-9681

"Strongly Disagree" to 5 = "Strongly Agree." The construct validity of this scale has been confirmed in previous studies, including those by Pekrun et al. (2002) and Nikdel (2013). In the present study, the Cronbach's alpha coefficient for this scale was 0.91.

2. Self-Regulated Learning Questionnaire: Self-regulated learning was assessed using the 14-item questionnaire developed by Bouffard et al. (1995). This instrument measures students' cognitive and metacognitive strategies and is scored on a 5-point Likert scale, with higher scores indicating higher levels of self-regulated learning. In previous studies, the reliability coefficients of this questionnaire ranged from 0.71 to 0.77 (Kadivar, 2001; Mahmudi, 2002). In the present study, the Cronbach's alpha coefficient for this instrument was 0.69.

3. Achievement Emotions Questionnaire: The Achievement Emotions Questionnaire (AEQ), developed by Pekrun et al. (2002), is one of the most comprehensive instruments for assessing emotions associated with academic situations. This questionnaire consists of 155 items and evaluates a range of positive emotions, such as enjoyment, hope, and pride, as well as negative emotions, such as anger, anxiety, shame, hopelessness, and boredom. Responses are recorded on a 5-point Likert scale. In Iranian studies, the reliability of the subscales of this instrument has been reported to range from 0.84 to 0.92 (Kadivar et al., 2012). In the present study, the overall reliability coefficient of this instrument was 0.81.

2.3. Data Analysis

The data were analyzed using both descriptive and inferential statistical methods. In the descriptive section, frequency, percentage, mean, and standard deviation were used. In the inferential section, Structural Equation Modeling (SEM) was employed to examine the structural relationships among the variables and to test the mediating role of achievement emotions. In addition, Pearson's correlation coefficient was calculated to examine the preliminary relationships among the variables. All analyses were performed using IBM SPSS Statistics version 24 and LISREL version 8.5.

3. Findings and Results

The data analysis process for this study was conducted to elucidate the structural relationships among self-regulated learning, academic emotions, and academic boredom in female high school students in Tehran, utilizing the Structural Equation Modeling (SEM) approach. To ensure the accuracy of the results, descriptive analyses and statistical assumptions were first examined, followed by the evaluation of the measurement and structural models. In this regard, the study's sample comprised 375 female students; following the sampling and final screening process, their demographic information was collected. The frequency distribution of participants by age group is reported in Table 1, indicating a suitable age distribution across the upper secondary levels.

Table 1

Frequency Distribution and Percentage of Participants by Age

Age Group (Years)	Frequency	Percentage
15	98	26.1
16	112	29.9
17	95	25.3
18 and above	70	18.7
Total	375	100.0

Concurrently with the examination of demographic characteristics, descriptive statistics, including mean and standard deviation, were calculated to understand the overall status of the variables, as detailed in Table 2. The results of this section indicate that the mean scores of the study variables are at a moderate level, suggesting a symmetrical distribution of responses on the Likert scale employed.

E-ISSN: 2980-9681

Table 2

Descriptive Statistics of the Main Study Variables

Study Variables	Mean	Standard Deviation
Self-Regulated Learning	3.36	0.61
Academic Emotions	3.13	0.71
Academic Boredom	3.38	0.62

After outlining the descriptive profile of the data, it was essential to examine the relationships among the constructs bivariately before testing the structural model. For this purpose, the Pearson correlation matrix was calculated, the results of which are reflected in Table 3. These findings indicate that all correlation coefficients are statistically significant at the 0.01 level, being either positive or negative, which provides the necessary prerequisite for proceeding to structural modeling.

Table 3

Pearson Correlation Matrix Among Main Variables

Variables	1	2	3
1. Self-Regulated Learning	1.00		
2. Academic Emotions	0.43**	1.00	
3. Academic Boredom	-0.45**	-0.57**	1.00

In the subsequent step, to ensure the model fit of the measurement models and the validity of the constructs, Confirmatory Factor Analysis (CFA) was performed. The goodness-of-fit indices reported in Table 4 include the chi-square to degrees of freedom ratio (χ^2/df), the Comparative Fit Index (CFI), the Goodness-of-Fit Index (GFI), and the Root Mean Square Error of Approximation (RMSEA). The obtained values in this table indicate that the measurement models exhibit a desirable fit with the empirical data, and the factor loadings for each construct are at an acceptable significance level.

Table 4

Goodness-of-Fit Indices for Measurement Models (CFA)

Latent Construct	χ^2/df	RMSEA	CFI	GFI
Self-Regulated Learning	1.58	0.054	0.94	0.92
Academic Emotions	2.99	0.055	0.92	0.90
Academic Boredom	2.25	0.057	0.91	0.89

Upon confirmation of the measurement model, the study proceeded to the final stage: testing the structural model and examining the causal relationships among the variables. In this model, direct relationships among the variables were investigated. The findings from the standardized path coefficients indicate that self-regulated learning has a significant negative effect on academic boredom. Furthermore, the paths from self-regulated learning to academic emotions and its effects on academic boredom were also significantly confirmed, with their coefficients summarized in Table 5.

Table 5

Direct Path Coefficients in the Structural Model

Direct Path	Standardized Coefficient (β)	t-statistic	Significance Level
Self-Regulated Learning →Academic Boredom	-0.61	11.42	0.001
Self-Regulated Learning →Academic Emotions	0.11	3.21	0.01
Academic Emotions →Academic Boredom	-0.21	4.08	0.001

E-ISSN: 2980-9681

In addition to examining the direct effects, the Sobel test was employed to investigate the mediating role of academic emotions in the relationship between self-regulated learning and academic boredom. The results presented in Table 6 indicate that academic emotions, as a mediating variable, significantly facilitate the relationship between self-regulated learning and the reduction of academic boredom in an indirect manner.

Table 6

Indirect Path Analysis (Mediation Role)

Indirect Path	Indirect Effect	Sobel Test (Z)	Significance Level
Self-Regulated Learning →Emotions →Boredom	-0.02	3.42	0.001

Finally, by synthesizing the aforementioned findings, it can be stated that the model of this study clearly demonstrates that self-regulated learning, as a predictor construct, plays a key role in reducing students' academic boredom in the mathematics classroom. This effect is established both directly and indirectly (through the enhancement of positive academic emotions). In other words, students who employ stronger self-regulation strategies experience less academic boredom, accompanied by more positive academic emotions. This model, by considering the aforementioned variables, provides suitable explanatory power for the academic experience of female students in mathematics, and its findings are in complete alignment with Pekrun's Control-Value Theory.

4. Discussion and Conclusion

The findings of the present study demonstrated that self-regulated learning had a direct and significant negative effect on academic boredom in mathematics among female high school students. In addition, self-regulated learning showed a positive and significant relationship with academic emotions, while academic emotions were negatively associated with academic boredom. Furthermore, the mediation analysis confirmed that academic emotions significantly mediated the relationship between self-regulated learning and academic boredom. Overall, the results suggest that students who possess stronger self-regulatory competencies experience more adaptive emotional responses toward learning and consequently report lower levels of boredom in mathematics. These findings support the proposed theoretical model and provide evidence that both cognitive-regulatory and emotional processes contribute substantially to students' academic experiences.

The finding indicating a significant negative relationship between self-regulated learning and academic boredom is consistent with contemporary theories of learning and motivation. Self-regulated learning is conceptualized as an active process through which learners set goals, monitor progress, evaluate outcomes, and regulate their cognition, motivation, and behavior to achieve desired academic objectives (Hadwin et al., 2020; Schunk, 2023). Students who engage in self-regulation are more likely to perceive themselves as active participants in learning rather than passive recipients of information. Such active engagement increases task involvement and reduces the likelihood of experiencing monotony and disengagement. From this perspective, boredom emerges when learners perceive insufficient challenge, low relevance, or limited personal control over learning activities. Self-regulated learners are better equipped to manage these conditions by adjusting strategies, setting meaningful goals, and maintaining attention to learning tasks. Therefore, the observed inverse relationship between self-regulated learning and boredom is theoretically expected and reflects the adaptive role of self-regulation in educational settings.

The present findings align with previous studies reporting beneficial effects of self-regulated learning on educational adjustment and achievement. Research has consistently demonstrated that self-regulated learners exhibit greater academic success, stronger persistence, and higher engagement in educational activities (Tabatabaei & Ghaderi, 2018; Tavakoli, 2016). Meta-analytic evidence has further shown that self-regulatory strategies are among the strongest predictors of academic achievement across different educational levels (Zeighamian & Moeinikia, 2019). Because boredom often develops when students fail to maintain engagement with academic tasks, the capacity to regulate attention, effort, and learning strategies likely functions as a protective factor against boredom. The present findings also support previous evidence indicating that self-regulated learning contributes to reducing academic boredom by increasing students' sense of competence and

E-ISSN: 2980-9681

effectiveness in learning situations (Hosseini-Manesh, 2019).

Another important finding was the significant positive effect of self-regulated learning on academic emotions. This result suggests that students who effectively regulate their learning processes are more likely to experience favorable emotional states during academic activities. Theoretically, self-regulated learners possess greater confidence in their ability to manage educational demands and overcome learning challenges. Such experiences promote feelings of competence, mastery, hope, and satisfaction. Learning theories emphasize that successful self-regulation enhances perceptions of agency and control, which are closely associated with positive emotional experiences (Schunk, 2023). Similarly, self-regulated learners are more capable of interpreting setbacks as opportunities for growth rather than indicators of failure, thereby maintaining more adaptive emotional responses toward learning tasks.

This finding is consistent with previous studies highlighting the close association between learning strategies and academic emotions. Research has demonstrated that students who utilize effective learning strategies tend to report higher levels of enjoyment, interest, and satisfaction with learning experiences (Wu et al., 2021). Studies conducted in educational contexts have also shown that academic emotions are strongly influenced by students' motivational beliefs, self-perceptions, and strategic learning behaviors (Mousavi et al., 2017). Furthermore, recent evidence suggests that academic motivation, emotional regulation, and self-regulation operate together to shape students' approaches to learning and educational engagement (Rentzios et al., 2025). Therefore, the positive association observed in the present study reflects an important psychological pathway through which self-regulated learning contributes to educational adjustment.

The results further revealed that academic emotions had a significant negative effect on academic boredom. Students who reported more positive academic emotions experienced lower levels of boredom in mathematics. This finding is highly consistent with the theoretical propositions of achievement emotion research. According to contemporary educational psychology perspectives, emotions influence how students process information, allocate attention, interpret learning experiences, and engage with academic tasks (Pekrun, 2022; Pekrun et al., 2022). Positive emotions facilitate curiosity, persistence, cognitive flexibility, and engagement, whereas negative emotional states often undermine motivation and learning effectiveness. When students experience enjoyment, hope, pride, and satisfaction, they are more likely to remain cognitively and behaviorally involved in learning activities. Consequently, boredom becomes less likely to emerge.

The present findings are supported by substantial empirical evidence. Meta-analytic research has demonstrated that achievement emotions significantly predict academic performance and engagement (Camacho-Morles et al., 2021). Similarly, systematic reviews have confirmed that positive academic emotions contribute to higher achievement and more adaptive learning outcomes (Liu et al., 2023). Educational scholars have repeatedly emphasized that emotions are not peripheral aspects of learning but central determinants of educational success (Ge, 2021). Furthermore, recent predictive models indicate that negative academic emotions play a crucial role in shaping students' educational experiences and behavioral outcomes (Ma et al., 2025). Therefore, the negative association between academic emotions and boredom observed in this study is both theoretically and empirically well supported.

The mediation findings represent one of the most important contributions of the present research. The results demonstrated that academic emotions significantly mediated the relationship between self-regulated learning and academic boredom. In other words, self-regulated learning reduced boredom not only directly but also indirectly through its influence on academic emotions. This finding provides strong support for integrative models that emphasize the interaction between cognitive-regulatory and emotional processes in academic functioning. Students who effectively regulate their learning are more likely to experience positive emotions such as enjoyment, confidence, and hope. These emotions subsequently enhance engagement and reduce feelings of boredom. Thus, academic emotions serve as an important psychological mechanism through which self-regulation affects students' educational experiences.

This mediation pattern is particularly consistent with Pekrun's Control-Value Theory of Achievement Emotions. According to this theory, students' emotions arise from their perceptions of control over learning activities and the value they attribute to academic tasks (Pekrun et al., 2022). Self-regulated learners generally perceive greater control because they possess effective strategies for managing learning demands. These perceptions of control foster positive emotions, which subsequently promote engagement and reduce boredom. Consequently, the indirect pathway identified in the present study is fully compatible with the

E-ISSN: 2980-9681

theoretical assumptions of achievement emotion theory. Similar findings have been reported in studies examining the mediating role of academic emotions between motivational variables and educational outcomes (Camacho-Morles et al., 2021; Mousavi et al., 2017).

The present results also contribute to the growing literature on academic boredom in mathematics. Mathematics is often associated with emotional challenges due to its abstract content, cumulative structure, and high cognitive demands (Ashcraft & Moore, 2021). Educational organizations have repeatedly emphasized the importance of addressing emotional barriers to mathematics learning in order to improve student outcomes (National Council of Teachers of, 2022). Research has shown that mathematics-related boredom is associated with lower achievement, reduced persistence, and decreased motivation (Ahmadi & Yousefipour, 2020; Habibi & Mansournia, 2018). Moreover, systematic reviews have identified boredom as a significant obstacle to academic development across educational contexts (Ren et al., 2023). The present study extends this literature by demonstrating that self-regulated learning and academic emotions represent important protective factors against boredom in mathematics.

Another noteworthy aspect of the findings concerns the broader implications of negative emotional experiences in educational settings. Recent studies have shown that negative emotions contribute to a variety of maladaptive outcomes, including academic procrastination, stress-related difficulties, and problematic behavioral patterns (Cao et al., 2025; Kim et al., 2025). Similarly, academic boredom has been associated with reduced achievement, burnout, and disengagement (Bekker & Rothmann, 2023). Studies examining achievement goals have also indicated that boredom is linked to less adaptive motivational profiles and poorer educational outcomes (Mavrou, 2023; Putwain et al., 2021). Consequently, reducing boredom may have benefits extending beyond academic performance and may contribute to students' overall psychological well-being and educational adjustment.

The findings should also be interpreted within the broader educational context. International evidence suggests that students' experiences at school are strongly influenced by emotional factors and perceptions of educational quality (Oecd, 2020). Furthermore, investigations of boredom have shown that students may become bored when learning activities are perceived as either excessively difficult or insufficiently challenging (Krannich et al., 2019). The Meaning and Attentional Components Model of boredom proposes that boredom emerges when individuals struggle to maintain meaningful engagement with ongoing activities (Westgate & Wilson, 2018). Self-regulated learning may help address both components by enabling students to sustain attention and create personal meaning within academic tasks. Therefore, the present findings contribute to a deeper understanding of how cognitive and emotional resources interact to shape educational experiences.

Overall, the results indicate that self-regulated learning functions as an important protective factor against academic boredom in mathematics and that academic emotions play a substantial mediating role in this relationship. The findings support contemporary theories emphasizing the integration of cognitive, motivational, and emotional processes in learning and highlight the importance of addressing both self-regulatory competencies and emotional experiences when seeking to improve students' educational outcomes.

Several limitations should be acknowledged when interpreting the findings of this study. First, the research employed a cross-sectional correlational design, which limits the ability to draw definitive causal conclusions regarding the relationships among self-regulated learning, academic emotions, and academic boredom. Second, the sample consisted exclusively of female high school students in Tehran, which may restrict the generalizability of the findings to male students, other age groups, or students from different cultural and educational contexts. Third, all variables were measured using self-report questionnaires, making the results susceptible to response biases such as social desirability and common method variance. Finally, other potentially influential variables, including teacher characteristics, classroom climate, parental involvement, and academic achievement, were not incorporated into the proposed model.

Future studies should employ longitudinal and experimental designs to clarify the causal relationships among self-regulated learning, academic emotions, and academic boredom. Researchers are encouraged to replicate the model across different educational levels, academic disciplines, and cultural contexts to examine its generalizability. Future investigations may also explore additional mediating and moderating variables, such as academic motivation, self-efficacy, resilience, classroom engagement, teacher support, and emotion regulation strategies. Furthermore, qualitative approaches could provide deeper insights into students' subjective experiences of boredom and the mechanisms through which self-

E-ISSN: 2980-9681

regulation influences emotional experiences in educational settings.

Educational practitioners should prioritize the development of self-regulated learning skills through systematic instruction in goal setting, planning, self-monitoring, reflection, and strategic learning. Teachers can reduce boredom by designing meaningful, appropriately challenging, and personally relevant learning activities that encourage active participation. Schools should also promote emotionally supportive classroom environments that foster positive academic emotions such as enjoyment, hope, and confidence. Professional development programs for teachers may focus on identifying signs of academic boredom and implementing evidence-based strategies to enhance engagement. In addition, school counselors and educational psychologists can design intervention programs aimed at strengthening both self-regulatory competencies and positive emotional experiences in mathematics learning.

Authors' Contributions

All authors significantly contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We hereby thank all individuals for participating and cooperating us in this study.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethical Considerations

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the study and participated in the research with informed consent.

References

Ahmadi, M., & Yousefipour, N. (2020). Academic Boredom and Academic Performance in Mathematics Students. *Educational Sciences Research*, *18*(2).

Ashcraft, M. H., & Moore, A. W. (2021). Mathematics Anxiety and Mathematics Education: Current Issues and Future Directions. In *The Oxford Handbook of Numerical Cognition and Mathematics* (pp. 837-856). Oxford University Press.

Bekker, C., & Rothmann, S. (2023). The Happy Learner: Effects of Academic Boredom, Burnout and Engagement. *Frontiers in psychology*, *13*, 974486. https://doi.org/10.3389/fpsyg.2022.974486

Camacho-Morles, J., Slemp, G. R., Pekrun, R., Loderer, K., Hou, H., & Oades, L. G. (2021). Achievement Emotions and Academic Performance: A Meta-Analysis. *Educational psychology review*, *33*, 1051-1095. https://doi.org/10.1007/s10648-020-09585-3

Cao, C., Chen, D., & Zhou, Y. (2025). Perceived stress and academic procrastination among higher vocational nursing students: The mediating roles of positive and negative emotions. *BMC Nursing*, *24*(1), 36.

Ge, X. (2021). Emotion Matters for Academic Success. *Educational Technology Research and Development*, *69*(1), 67-70.

Habibi, L., & Mansournia, M. (2018). Cognitive Factors Influencing Academic Boredom in Mathematics. *Research in Curriculum Planning*, *15*(3).

Hadwin, A. F., Matus, T., & Scavarelli, A. (2020). Self-Regulated Learning as a Framework for Understanding and Supporting Students' Academic Success. In *The Routledge International Handbook of Self-Regulated Learning* (pp. 3-17). Routledge.

Hosseini-Manesh, S. (2019). The Role of Self-Regulated Learning in Reducing Academic Boredom. *Quarterly Journal of Educational Psychology*, *13*(1).

Kim, J. A., Choi, J. I., Lee, S. J., & Jeong, E. J. (2025). The Influence of Negative Emotions on Adolescents' Pathological Gaming: The Role of Self-Control in the Associations With Aggression, Academic Stress, and Pathological Gaming. *Frontiers in psychology*, *16*. https://doi.org/10.3389/fpsyg.2025.1539162

Krannich, M., Goetz, T., Lipnevich, A. A., Bieg, M., Roos, A., & Becker, E. S. (2019). Being Over- or Underchallenged in Class: Effects on Students' Career Aspirations via Academic Self-Concept and Boredom. *Learning and Individual Differences*, *69*, 206-218. https://doi.org/10.1016/j.lindif.2018.10.004

Liu, Y., Chen, S., & Wang, J. (2023). A Systematic Review of the Relationship between Academic Emotions and Academic Achievement. *Educational psychology review*, *35*(1), 1-35.

Ma, S., Jia, N., Wei, X., & Zhang, W. (2025). Constructing a predictive model of negative academic emotions in high school students based on machine learning methods. *Scientific reports*, *15*(1), 19183. https://doi.org/10.1038/s41598-025-04146-6

Mavrou, K. (2023). The Role of Goal Orientation in Academic Boredom and Achievement. *Learning and Instruction*, *85*, 101750.

Mousavi, S., Abolmaali, K., & Mirhashemi, M. (2017). The Mediating Role of Academic Emotions in the Relationship between Constructivist Learning Environment and Academic

E-ISSN: 2980-9681

Competence among Female Secondary School Students. *8*(2), 79-95.
National Council of Teachers of, M. (2022). *Catalyzing Change in Early Childhood Education*. National Council of Teachers of Mathematics.
Oecd. (2020). *PISA 2018 Results, Volume III: What School Life Means for Students' Lives*.
Pekrun, R. (2022). Emotions in Education. In *The Cambridge Handbook of the Learning Sciences* (3rd ed., pp. 339-357). Cambridge University Press.
Pekrun, R., Linnenbrink-Garcia, L., & Daniels, L. M. (2022). Affective Factors in Education. In *Handbook of Research on Learning and Instruction* (pp. 329-365). Routledge.
Phan, A. L. T., Vo, V. V., & Nguyen, H. L. (2024). Factors Contributing to Academic Boredom among English Major Students at Nong Lam University. *Vietnam Journal of Education*, *8*(1), 38-50. https://doi.org/10.52296/vje.350
Putwain, D. W., Becker, S., & Symes, W. (2021). Academic Boredom, Achievement Goals, and Achievement Outcomes. *Contemporary Educational Psychology*, *65*, 101970.
Ren, B., O'Callaghan, J., & Pekrun, R. (2023). The Experience of Academic Boredom: A Systematic Review. *Educational Psychology*, *43*(5), 541-560.
Rentzios, C., Karagiannopoulou, E., & Ntritsos, G. (2025). Academic Emotions, Emotion Regulation, Academic Motivation, and Approaches to Learning: A Person-Centered Approach. *Behavioral Sciences*, *15*(7), 900. https://doi.org/10.3390/bs15070900
Schunk, D. H. (2023). *Learning Theories: An Educational Perspective*. Pearson.
Tabatabaei, S. M., & Ghaderi, F. (2018). Self-Regulated Learning and Its Effect on Students' Academic Achievement. *Quarterly Journal of Psychological Studies and Educational Sciences*, *4*(1), 126-134.
Tavakoli, M. (2016). A Meta-Analysis of the Relationship between Self-Regulated Learning Strategies and Motivational Strategies with Academic Achievement. *Quarterly Journal of Educational Psychology*, *16*(1), 95-115.
Tze, V. M. C., Daniels, L. M., & Klassen, R. M. (2016). Evaluating the Relationship between Boredom and Academic Outcomes: A Meta-Analysis. *Educational psychology review*, *28*(1), 119-144.
Westgate, E. C., & Wilson, T. D. (2018). Boring Thoughts and Bored Minds. In *Advances in experimental social psychology* (Vol. 58, pp. 1-74). Academic Press.
Wu, C., Jing, B., Gong, X., Mou, Y., & Li, J. (2021). Students' Learning Strategies and Academic Emotions: Their Influence on Learning Satisfaction during the COVID-19 Pandemic. *Frontiers in psychology*, *12*, 717683.
Zeighamian, F., & Moeinikia, M. (2019). A Meta-Analysis of Factors Affecting Self-Regulatory Strategies in Learning. *Quarterly Journal of Educational Psychology*, *15*(54), 33-57.

E-ISSN: 2980-9681