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Testing a Causal Model of Mathematics Academic Boredom Based on Metacognitive Strategies and Achievement Goal Orientation with the Mediating Role of Academic Procrastination

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

1. PhD student in Educational Psychology, Faculty of Literature, Humanities and Social Sciences, Science and Research Branch, Islamic Azad University, Tehran, Iran. E-mail: elhamnikookarpsy@gmail.com
2. *Corresponding Author*, Department of Measurement and Assessment, Faculty of Psychology and Education, Allameh Tabatabae'i University, Tehran, Iran. E-mail: farrokhi@atu.ac.ir
3. Full Professor, Department of Educational Psychology, Faculty of Psychology and Education, Allameh Tabatabae'i University, Tehran, Iran. E-mail: dortaj@atu.ac.ir
4. Associate Professor of Endocrinology, Metabolism Vice Chancellery for Treatment, Iran Ministry of Health and Medical Education, Tehran, Iran. E-mail: ghaemi@health.gov.ir

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ABSTRACT

Objective: Academic boredom, as one of the key negative emotions in educational environments, particularly in mathematics, can lead to numerous effects. The present study was conducted with the aim of examining the model of mathematics academic boredom based on metacognitive strategies and goal orientations, mediated by academic procrastination, among high school students.

Method: This research was descriptive in nature employing structural equation modeling and path analysis. The statistical population included all female high school students in public schools in Tehran during the academic year 2024-2025, from which 400 individuals were selected using multi-stage cluster sampling. Data collection tools included the Academic Boredom Questionnaire (Pekrun et al., 2002), Self-Regulated Learning Questionnaire (Bouffard et al., 1995), Goal Orientations Questionnaire (Bouffard et al., 1998), and Academic Procrastination Questionnaire (Solomon & Rothblum, 1984). The data were analyzed using path analysis in SPSS 24 and AMOS 2024 software.

Results: The results indicated that the proposed model has a good fit. Metacognitive strategies (β=-0.13) and mastery goal orientation (β =-0.29), performance goal orientation (β= 0.19), and avoidance goal orientation (β= 0.05) had a direct and significant effect on mathematics academic boredom. Furthermore, academic procrastination mediated the relationship between goal orientations and academic boredom.

Conclusions: These findings can inform the design of effective educational interventions to reduce academic boredom, emphasizing the strengthening of metacognitive strategies and promotion of mastery goal orientations as key self-regulatory tools. Such approaches not only mitigate academic procrastination but also enhance overall motivation and academic performance.

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Introduction

In the present-day world of education, mathematics education, as one of the fundamental pillars of the education system, plays a central role in developing cognitive skills, problem-solving, and preparing individuals for professional life challenges. However, many students encounter motivational and emotional barriers when facing mathematical content, which can affect their academic performance, one of which is called “academic boredom”. Academic boredom is a silent but complex and important aspect of achievement emotions that has a negative relationship with optimal learning in educational environments (Acee et al., 2010; Pekrun, 2006). This phenomenon can disrupt the physical and psychological health of learners, damage their perceptions of their abilities, and lead to feelings of inefficiency (Ayaz & Jawad, 2024). Research shows that overall reduction in quality of life and life satisfaction (Abdellatif, 2022), academic burnout and learner withdrawal from educational activities, as well as lower levels of performance, are among the consequences of academic boredom (Schwartze et al., 2021; Tze et al., 2014; Weybright et al., 2020).

Academic boredom is defined as a feeling of fatigue toward completing homework, a negative perception of school and learning, and a feeling of inadequacy. In fact, academic boredom is the experience of a negative emotion whereby students do not pay the necessary attention to lessons and homework, to the extent that this condition negatively impacts learning motivation, as well as cognitive and metacognitive learning resources (Sharp et al., 2017). Psychological studies indicate that many adolescents during their schooling period frequently feel boredom and perceive the educational environment as monotonous. This situation can lead to a decrease in academic motivation and even, in severe cases, to school dropout (Grazia et al., 2021; Respondek et al., 2017). Therefore, given the prevalence of academic boredom in educational environments and its negative consequences on academic achievement, identifying the underlying and influencing factors on this phenomenon for providing effective strategies is of great importance.

In examining these factors, metacognitive strategies, as one of the self-regulatory mechanisms that students employ to manage emotions and optimize their learning processes, gain special importance (Layco, 2020). These strategies can help students cope with negative emotions such as boredom and improve their working memory and academic performance (Farazandeh et al., 2023). Metacognitive skills usually include planning, monitoring, and evaluation of learning activities; components that enable learners to adjust their behavior, motivation, and cognition in the path to achieving more desirable outcomes (Pintrich et al., 2000; Roberts, 2021). In general, metacognitive strategies are constructive and dynamic processes in which learners set learning goals, monitor the learning process, and exert cognitive control over their motivation and emotions (ElSayad, 2024).

The research by Mahbod and Yousefi (2022) showed that metacognition directly predicts academic vitality in students. Mahigir (2025) also demonstrated the effect of teaching metacognitive strategies on academic vitality and creativity in children. Additionally, Layco (2020) in a study examined the role of metacognition and its interaction with negative emotions on resilience and academic performance in mathematics. The implicit results of this research also showed the relationship between metacognition and negative emotions, including anxiety, anger, boredom, and despair.

In order to gain a deeper understanding of the factors influencing academic boredom, goal orientations have been considered by researchers as one of the fundamental motivational constructs; a construct that significantly affects students' engagement with homework and consequently their academic emotions, including boredom (Sadoughi & Eskandari, 2025). Based on the achievement goal orientation theory, individuals' inclinations toward goals and the reasons for their participations in achievement-oriented activities guide the path of their efforts to achieve competence (Chazan et al., 2022). In fact, goal orientation is a mental framework that determines an individual's interpretation of goal-oriented situations and their response to them (Yeo & Neal, 2004). Accordingly, students with mastery goal orientation usually participate in the learning process with the aim of deeply understanding the material and developing their personal abilities. In contrast, individuals with performance goal orientation are more focused on proving competence and superior performance compared to others. On the other hand, avoidance goal orientation is associated with the individual's tendency to avoid showing inability and preventing negative evaluations from others, and it is usually linked to fear of failure, anxiety, reduced intrinsic motivation, and negative academic and psychological consequences (Elliot & Church, 1997; Miller et al., 2021). In this context, Abed et al. (2022), by developing a model for academic boredom, found that goal orientation has a direct and significant effect on academic boredom.

Given the key role of academic procrastination in explaining and shaping the cognitive and motivational outcomes of students, examining this variable as a mediator can lead to a deeper understanding of the relational mechanisms between emotions, metacognition, and goal orientations. Academic procrastination, as a maladaptive behavioral phenomenon, refers to the individual's recurrent tendency to postpone performing academic tasks or duties despite awareness of its negative consequences (Ferrari, 1991; Pérez-Jorge, 2024). This phenomenon includes behavioral, emotional, and cognitive components and is often referred to as a failure in self-regulation (Saplavska & Jerkunkova, 2018). The consequences of academic procrastination are extensive and negative and can include reduced academic achievement, higher levels of anxiety (Rezaei-Gazki et al., 2024), low self-esteem (Ghasempour et al., 2024), and reducing academic grit (Hendusinabad, & Sepehrianazar, 2024). Chen et al. (2024) in a study examined the mechanism of the relationship between negative academic emotions such as boredom and academic

procrastination, considering the mediating role of self-efficacy and goal orientations, and the results showed complex relationships between negative academic emotions and academic procrastination among students and emphasized the importance of goal orientation for preventing procrastination. Lin et al. (2021) also examined the relationship between achievement goal orientations and online academic procrastination among middle school students in a structural equation modeling and found that mastery-approach orientation was negatively and performance-avoidance orientation was positively associated with academic procrastination.

In summary, given the importance of academic boredom as one of the fundamental barriers in learning and academic achievement, especially in mathematics, which can lead to reduced motivation, performance decline, and even school dropout, it is essential to identify the cognitive and motivational factors influencing this construct. In this regard, metacognitive strategies and goal orientations, as key self-regulatory constructs, play a determining role in regulating emotions and academic behaviors. On the other hand, academic procrastination, as a dysfunctional behavior, can play a mediating role in the connection between these cognitive and motivational variables and negative emotions such as boredom. Despite the importance of these variables, no comprehensive research has been conducted so far that examines an integrated structural model of the causal relationships among academic boredom, metacognitive strategies, goal orientations, and academic procrastination. Accordingly, the aim of the present study was to test the proposed causal model of academic boredom in mathematics based on metacognitive strategies and goal orientations, mediated by academic procrastination, among high school students.

Materials and Methods

The present research adopted descriptive-correlational method using structural equation modelling.

Participants

The statistical population of the research included high school students in Tehran during the academic year 2023-2024. In this research, Soper's formula (2025) was used to determine the sample size, according to which, with an effect size of .1, statistical power level of .8, number of latent variables: 4, number of observable variables: 8, and the significance level of .05, the minimum sample size was estimated at 400 people, selected through multi-stage cluster sampling method. To describe the statistical data, Pearson correlation method with SPSS-24 software was used, and to fit the model under study in the research, path analysis method in AMOS-24 software was used.

Instruments

In the present research, the following tools were used to collect data:

Academic Boredom Questionnaire: This scale, designed by Pekrun et al. (2002), consists of 22 items and two subscales: class-related boredom and learning-related boredom. The scoring of this questionnaire is based on a 5-point Likert scale from 1 to 5. The score range is between 22 and 110. Pekrun et al. (2002), through exploratory factor analysis, demonstrated the construct validity of this scale as one of the subscales of the Achievement Emotions Questionnaire. They also reported the reliability using Cronbach's alpha method as .92. This scale was validated in Iran by Nikdel (1392), and Cronbach's alpha for the class-related boredom and learning-related boredom subscales were obtained as.84 and.86, respectively. In the present study, the Cronbach's alpha coefficient was obtained as .87.

Self-Regulated Learning Questionnaire: This questionnaire was developed by Bouffard et al. (1995) to assess self-regulation in students' learning. This questionnaire has 19 questions and 3 subscales: cognitive strategies, metacognitive strategies, and motivational strategies, and its scoring is conducted on a 5-point Likert scale. In this research, questions related to the metacognitive strategies subscale were used. A high score in each component indicates the individual's tendency to apply that component. The overall reliability of the questionnaire based on Cronbach's alpha is reported as .71, and .72 for the metacognitive strategies subscale (Bouffard et al., 1995). Kadivar (2001) also estimated the reliability coefficient of this questionnaire using Cronbach's alpha method as .71. Additionally, the results of factor analysis showed that the split-half correlation coefficient between questions was appropriate, and this test is able to explain .52 of the variance in self-regulation, and its construct validity is also at a desirable level (Kadivar, 2002). In the research by Abdulahi Beqrabadi and Heidary rad (2025), the Cronbach's alpha coefficient for the metacognitive strategies subscale was reported as .68. In the present study, the Cronbach's alpha coefficient was obtained as .70.

Academic Goal Orientation Questionnaire: This questionnaire was designed by Bouffard et al. (1998) and assesses the type of goal that an individual selects for themselves in academic situations. This questionnaire has 20 items, where items 2, 5, 9, 12, 14, 18 measure mastery goal orientation, items 1, 4, 7, 8, 11, 13, 16 measure performance goal orientation, and items 3, 6, 10, 15, 17, 19, 20 measure avoidance of failure goal orientation. The scoring of this scale is based on a 5-point Likert scale from strongly agree to strongly disagree. Bouffard et al. (1998) calculated the reliability coefficients using Cronbach's alpha method for the mastery, performance, and avoidance dimensions as .88, .75, and .75, respectively, and using the test-retest method, the reliability coefficients were obtained as .84, .81, and .81, respectively. In Iran, this scale was validated by Jokar (2005). The calculation of the correlation coefficients of each question with the total score of the relevant subscale indicated high correlations of the questions with the related components, and the reliability using Cronbach's alpha method for the mastery, performance, and avoidance

dimensions was obtained as .81, .63, and .70, respectively. In the present study, the Cronbach's alpha coefficients for each subscale were obtained as .71, .80 and .77.

Academic Procrastination Questionnaire: This questionnaire was developed by Solomon and Rothblum (1984). The instrument consists of 27 items that assess three components of academic procrastination. The first component, *preparing for examinations*, includes 6 items (Items 1–6); the second component, *preparing homework*, includes 9 items (Items 9–17); and the third component, *preparing end-of-term projects*, comprises 6 items (Items 20–25). Each item is rated on a five-point Likert scale ranging from *1 = never* to *5 = always*. It should be noted that items 2, 4, 6, 11, 13, 15, 16, 21, 23, and 25 are reversely scored. In Iran, the psychometric properties of this scale have been validated among university students, yielding a Cronbach's alpha coefficient of .91 for the total scale and a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of .88, confirming its reliability and construct validity (Jowkar & Delavarpoor, 2007). In the present study, the Cronbach's alpha coefficient was obtained as .92.

Results

In examining the respondents' age distribution, 20.8% were 15 years old, 25.1% were 16 years old, 22.4% were 17 years old, and 31.7% were 18 years old. The descriptive statistics of the study variables are presented in the table 1.

Table 1. Descriptive statistics of research variables

	Mean	SD	Skewness	Kurtosis
Mastery Goal Orientation	18.66	3.42	-.65	.30
Performance Goal Orientation	20.72	4.20	.27	.13
Avoidance Goal Orientation	20.15	4.17	.68	.28
MetaCognitive Learning Strategies	19.68	2.82	-.86	.045
Academic Procrastination	77.64	13.46	.54	.79
Mathematics Academic Boredom	66.94	10.39	.12	-.99

Subsequently, the Kolmogorov–Smirnov test was employed to examine the normality of the data. The results of this analysis are reported in Table 2.

Table 2. Results of the Kolmogorov–Smirnov Test

	Z	P
Mastery Goal Orientation	.061	.084
Performance Goal Orientation	.063	.137
Avoidance Goal Orientation	.046	.200*
MetaCognitive Learning Strategies	.050	0/040
Academic Procrastination	.041	.47
Mathematics Academic Boredom	.058	.041

As shown in Table 2, the results of the Kolmogorov–Smirnov test indicated that all variables were normally distributed (p > .05). Given that the correlation matrix provides the foundation for causal analysis—particularly in structural equation modeling—the correlation matrix of the study variables, including correlation coefficients and significance levels, is presented in Table 3..

Table 3. Bivariate correlation matrix among research variables

	1	2	3	4	5	6
Mastery Goal Orientation	1					
Performance Goal Orientation	-.70**	1				
Avoidance Goal Orientation	.72**	.78**	1			
MetaCognitive Learning Strategies	0/12*	-.16**	-.10	1		
Academic Procrastination	-.66**	-.69**	.72**	-.16**	1	
Mathematics Academic Boredom	-.64	-.64**	.60**	-.64**	.64**	1

**p < .01 * p < .05

As shown in Table 2, academic boredom was found to have a significant relationship with performance goal orientation, avoidance goal orientation, metacognitive strategies, and academic procrastination (P <.05). However, no significant relationship was observed between academic boredom and mastery goal orientation.

Subsequently, path analysis was conducted using AMOS 24 to test the proposed research model. Prior to performing the path analysis, univariate outliers were identified and removed using boxplots, while multivariate outliers were examined using the Mahalanobis distance statistic. After verifying and confirming the assumptions of the analysis, path analysis was employed to evaluate the proposed model. The results are presented in Figure 1.

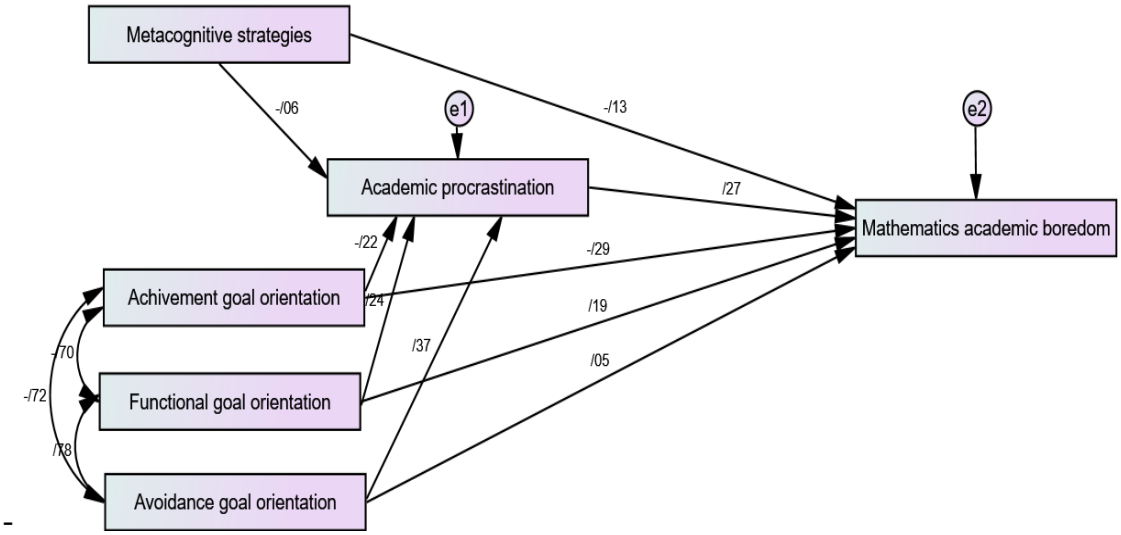

Figure 1. Standardized coefficients of the final model for the mediating role of academic procrastination between metacognitive strategies, goal orientation, and mathematics academic boredom

Figure 1 presents the standardized coefficients of the proposed model, illustrating the causal relationships of academic boredom in mathematics based on metacognitive strategies and goal orientation, with academic procrastination serving as the mediating variable. The model fit indices are presented in the following table.

Table 4. Model fit summary

Fix Index	(χ^2/ DF)	CFI	IFI	RMSEA	NFI	TLI
Accepted domain	1-5	> .9	> .9	.1>	> .9	> .9
observed value	3.16	.997	.997	.076	.995	**.997**

Table 4 presents the model fit indices. The ratio of the chi-square to degrees of freedom (χ^2/df) falls within the acceptable range of 1 to 5, confirming the adequacy of the model fit. The Incremental Fit Index (IFI) and Comparative Fit Index (CFI) both exceed the recommended threshold of .90, indicating good model fit and falling within the expected 0–1 range. Moreover, the Root Mean Square Error of Approximation (RMSEA) was .076, which is less than .10 and within the acceptable range. Therefore, the obtained coefficients indicate that the model demonstrates a satisfactory fit to the data.

Table 5. Direct, indirect, and total effects of the variables

From	To	Direct Effect	Sig	Indirect Effect	Sig	Total Effect
Metacognitive Learning Strategies	**Academic Procrastination**	-.62	.066	-	-	-.62
Mastery Goal Orientation		-.221	.001	-	-	-.221
Performance Goal Orientation		.242	.001	-	-	.242
Avoidance Goal Orientation		.369	.001	-	-	.369
Metacognitive Learning Strategies	**Academic Boredom**	-.129	.001	-.017	.048	-.062
Mastery Goal Orientation		-.287	.001	-.060	.001	-.221
Performance Goal Orientation		.189	.002	-.066	.001	.225
Avoidance Goal Orientation		.049	.045	.100	.000	.149
Academic Procrastination		.272	.001	-	-	.272

Table 5 presents the direct, indirect, and total effects among the model variables. Based on the results, metacognitive strategies had a significant negative direct effect on academic boredom ($\beta = -0.129$, $p < .01$) as well as a significant negative indirect effect through academic procrastination ($\beta = -0.017$, $p < .05$). Furthermore, avoidance goal orientation exhibited a significant positive indirect effect on mathematics academic boredom through academic procrastination ($\beta = .10$, $p < .01$).

Table 6. Bootstrap results for indirect relationships in the overall sample

Path / Indicator	Standardized Coefficients	Unstandardized Coefficients	Lower Bound	Upper Bound	p-value
The indirect effect of Metacognitive strategies on mathematics academic boredom via the mediating role of academic procrastination	-.014	-.049	-.037	.004	.124
The indirect effect of mastery goal orientation on mathematics boredom via the mediating role of academic procrastination	-.062	-.185	-.112	.028	.001
The indirect effect of performance goal orientation on mathematics learning boredom via the mediating role of academic procrastination	.068	.168	.029	.123	.001
The indirect effect of avoidance goal orientation on mathematics learning boredom via the mediating role of academic procrastination	.102	.250	.053	.173	.000

Bootstrap analysis was conducted to examine the indirect effects of the study variables through academic procrastination. As shown in Table 6, the indirect effect of metacognitive strategies on mathematics learning boredom was not significant, as the confidence interval included zero ($\beta = -.014$, $p > .05$). In contrast, the indirect effects of mastery goal orientation ($\beta = -.062$, $p < .01$), performance goal orientation ($\beta = .068$, $p < .01$), and avoidance goal orientation ($\beta = .102$, $p < .001$) on mathematics learning boredom through academic procrastination were statistically significant, with confidence intervals not including zero.

Further examination of the direct paths revealed that academic procrastination partially mediated the relationships between mastery and performance goal orientations and mathematics learning boredom. However, for avoidance goal orientation, the mediation effect was full, as the direct path became non-significant after the inclusion of the mediator.

Discussion

The present research was aimed at testing the causal structural model of mathematics academic boredom based on goal orientations and metacognitive strategies, mediated by academic procrastination among high school students whose results showed that this model has a good fit. The findings from testing the research hypothesis regarding the relationship between academic boredom and goal orientations showed that goal orientations have a direct and significant relationship with academic boredom. This finding was consistent with the finding by Abed et al. (2022). In explaining this finding, it can be stated that students whose goal is to acquire new skills and mastery over tasks, due to their interest in the subject matter and the pleasure they derive from engaging in educational activities, become more seriously involved in the learning process and

strive for more learning (Salehi et al., 2020). This greater effort and intrinsic motivation not only leads to better performance and their final effectiveness but can also reduce the risk of academic boredom and disinterest.

On the other hand, students with avoidance goal orientation have maladaptive patterns of motivation and mental health, as these individuals have the highest level of depression and the lowest level of self-esteem (Tuominen-Soini et al., 2008). Low self-esteem can lead to disinterest, lack of engagement in class discussions, lower self-efficacy, and consequently feelings of boredom and fatigue. Additionally, mastery goal orientation affects the learning of new skills and causes students to make greater efforts by providing appropriate information to improve old methods and correct failures or mistakes. They tend to consider achievement situations as opportunities to improve their abilities, have a positive attitude toward learning, and use goals and information to evaluate better performance (Shahbaziyankhonig et al., 2018). As a result, their academic vitality is higher. The findings from testing the research hypothesis regarding the relationship between academic boredom and metacognitive strategies showed that these strategies have a direct and significant relationship with academic boredom. This finding is consistent with those of Mahbod and Yousefi (2022), Mahigir (2025), and Layco (2020).

Metacognitive strategies begin with goal-setting, continue with planning to achieve the goal and identifying learning resources, and ultimately, the individual proceeds to monitor and evaluate their strengths and weaknesses during learning, which leads to maintaining motivation for continued learning (ElSayad, 2024). These types of strategies, in addition to increasing the amount of learning, can help increase self-awareness by enhancing self-confidence and motivation, and as a result, problem-solving ability and academic performance improve. Therefore, this type of learning, by engaging motivation, enthusiasm, and interest in learning, prevents mental and physical fatigue or academic boredom.

Additionally, since the use of metacognitive strategies has a positive and significant relationship with academic achievement (Celik, 2022), students who use these strategies tend to achieve better results. Improved performance and success in a subject can in turn reduce academic boredom in that subject. Furthermore, metacognitive strategies can lead to a reduction in the feeling of boredom by increasing students' engagement in the learning process and increasing their tendency to ask questions and resolve ambiguities (Gaylo, 2017), as students become actively involved with the content instead of being passive.

Regarding the mediating role, the findings of this study demonstrated that ‘academic procrastination was found to mediate the relationship between students’ goal orientations and mathematics learning boredom, whereas it did not mediate the effect of metacognitive strategies’. Within the framework of causal models, the lack of support for the mediating role may indicate the presence of other mediating pathways that were not included in the present model, thereby

preventing the emergence of an indirect effect through academic procrastination. Moreover, academic procrastination, rather than being merely a consequence of deficient metacognition, is influenced by motivational and emotional factors such as fear of failure, low self-efficacy, or avoidance goals. Consequently, the explanatory power of metacognitive strategies for predicting variations in academic procrastination may be insufficient, resulting in a non-significant indirect effect in the model.

Academic procrastination, which has roots in problems with emotion regulation as well as time management, acts as a maladaptive coping mechanism against negative emotions experienced in the learning process, especially in mathematics (Rad, 2025). Procrastinating students often face emotions such as anxiety, fatigue, lack of self-confidence, and anger, which stem from fear of failure, negative judgment, or inability to complete academic tasks on time (Pérez-Jorge, 2024). These negative emotions form a vicious cycle in which procrastination, by creating undesirable experiences and reinforcing stress, intensifies the initial negative emotions. In this regard, students' goal orientations play an important role; such that avoidance orientations can increase procrastination, while mastery orientations are associated with its reduction (Yousefi Afrashteh & Janjani, 2024). Furthermore, some research has shown that avoidance goals can predict procrastination through behavioral avoidance coping strategies (Zhou et al., 2017). These coping strategies include avoiding confrontation with difficult or tiring tasks and postponing them, which itself can lead to a feeling of boredom in the long term. This delay and lack of active engagement with the content can make mathematics tasks seem boring and meaningless and ultimately lead to academic boredom. In other words, students who have avoidance goals procrastinate more, and this procrastination, by distancing them from the active learning process, provides the ground for experiencing academic boredom.

This research has faced some limitations that should be considered in interpreting the findings. Given the nature of the proposed causal model, although structural equation modeling has been used to examine the relationships between variables, the cross-sectional design of the research limits the possibility of definitive causal inference. Self-report instruments may threaten internal validity due to the influence of social desirability. Additionally, the findings of this research may limit the generalization of results to other groups due to the specific sampling and the cultural-social context of the study.

It is recommended that school environments and learning spaces be designed and developed in such a way that the experience of negative emotions is minimized, and by strengthening positive emotions, students' motivation and enthusiasm for learning are increased. Such an approach can prevent the occurrence of academic boredom, and consequently, the decline in academic performance. Additionally, for future research, it is suggested to examine the role of emerging factors such as the application of artificial intelligence and digital tools (including adaptive learning

applications in mathematics) as learning strategies in the form of mediating variables. Furthermore, the development of studies among different age and gender groups is also recommended.

Author Contributions

The first author was responsible for the preparation and setup of samples, conducting experiments and data collection, statistical analysis of data, analysis and interpretation of information and results, preparation of the article draft. The second author (thesis supervisor) was responsible for research design, supervision of research stages, review and control of results, revision, review, and finalization of the article and the third author (thesis advisor) participated in research design, supervision of research, study and review of the article. The fourth author (thesis advisor) reviewed the research processes and the article.

Data Availability Statement

Data available on request from the authors.

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Ethical considerations

The authors avoided from data fabrication and falsification.

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Conflicts of Interest

The authors declare no conflicts of interest.

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