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The Influence Of Grit, Self-Efficacy, And Academic Anti-Procrastination On Mathematical Problem-Solving Ability

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Abstract

This study aims to analyze the effect of perseverance (grit) and self-efficacy on students' mathematical problem-solving abilities with academic anti-procrastination as a mediating variable. This study uses a quantitative approach with an ex post facto research type. Data were collected through questionnaires of perseverance, self-efficacy, academic anti-procrastination, and a mathematical problem-solving ability test. Data analysis was performed using Structural Equation Modeling–Partial Least Square (SEM-PLS) with the help of the Smart-PLS application. The results showed that perseverance has a positive and significant effect on academic anti-procrastination with a path coefficient of 0.779 and a p-value of 0.779. Academic anti-procrastination has a positive and significant effect on mathematical problem-solving abilities with a path coefficient of 0.000 and a p-value of 0.219. However, perseverance does not have a significant effect on mathematical problem-solving abilities with a p-value of 0.038. Self-efficacy also had no significant effect on academic anti-procrastination or mathematics problem-solving ability, with p-values of 0.238 and 0.098, respectively. The results of the indirect effect test showed that academic anti-procrastination mediated the effect of perseverance on mathematics problem-solving ability (0.605, 0.098), with an indirect effect coefficient of 0.170 and a p-value of 0.170. However, academic anti-procrastination failed to mediate the effect of self-efficacy on mathematics problem-solving ability (0.042). Based on the results of the study, it can be concluded that academic anti-procrastination plays an important role in supporting students' mathematics problem-solving ability and acts as a mediator in the relationship between perseverance and

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mathematics problem-solving ability (0.632).

Keywords: perseverance, self-efficacy, academic anti-procrastination, mathematics problem-solving ability, SEM-PLS.

INTRODUCTION

Education is the main pillar of quality human resource development. Mathematics is one of the basic and universal sciences that has an important role in human life. Mathematics is an important foundation for a person to be able to face problems and challenges in various aspects (Rusmana, 2019). In the context of the 21st century, students are required to have high-level thinking skills, one of which is the ability to solve problems. The importance of mathematical problem-solving skills is in line with the goals set forth by *National Council of Teachers of Mathematics* (NCTM). NCTM (2000) stated that there are five basic abilities that are used as standards in the mathematics learning process, namely problem solving (*problem solving*), communication (*communication*), connection (*connection*), representation (*representation*), as well as reasoning and proof (*reasoning and proof*). Mathematical problem-solving skills are an important skill in 21st century learning. In the context of the 21st century, students are required to have high-level thinking skills, one of which is the ability to solve problems (Nahdi, 2022).

The reality that occurs in the field is that the mathematical problem-solving ability of students in Indonesia is still relatively low. Nuryana & Rosyana (2019) revealed that the majority of students experience various types of errors in solving problem solving problems, ranging from misunderstandings to conclusions. The problem of low mathematical problem ability has become a national phenomenon that has been highlighted in various research surveys. Based on results *Programme for International Student Assesment* (PISA) 2022 organized by the OECD, only 18% of Indonesian students managed to reach level 2 or higher in mathematical literacy. This figure is very far behind the OECD average which reaches 69% (OECD, 2023).

The results of the analysis in several literature reviews also stated that students' problem skills are still lacking. In research (Pirmanto et al., 2020) It was stated that the ability of students to understand problems was relatively low, which was around 28%, the ability to plan solutions was low at around 32%, the ability to solve problems was very low at around 16%, and the ability to re-examine was very low, which was around 8%. Similar conditions were also found in students in South Kuta District, Badung Regency, Bali. Based on the results of interviews with several mathematics teachers in South Kuta, most students still have difficulties in solving problems that require in-depth analysis and applying mathematical concepts. This is reinforced by the results of

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daily tests which show that around 60% of students get scores below the Minimum Completeness Criteria (KKM) for questions that require problem-solving strategies.

Based on the literature review above, research on students' difficulties in solving mathematical problems has been carried out a lot. However, it is different from previous studies that generally reviewed from the cognitive aspect. Based on the framework of self-regulation, problem-solving ability is not only determined by cognitive aspects, but also psychological factors. This research focuses on the psychological aspects that affect the mathematical problem-solving ability. Some of the psychological factors that are believed to affect mathematical problem-solving ability are *grit, self-efficacy,* and academic procrastination.

These phenomena reinforce the importance of reviewing the mathematics learning process not only in terms of mastery of the material, but also in terms of the character and learning attitude of students. Based on the description above, it can be seen that the low mathematical problem-solving ability of high school students in South Kuta District, Badung Regency is not only related to cognitive aspects, but also greatly influenced by internal psychological factors, such as *self-efficacy*, *grit*, and *academic procrastination*.

Based on the above phenomenon, it can be concluded that mathematical problem-solving ability is influenced by psychological factors such as *self-efficacy, grit,* and academic procrastination. *self-efficacy* and *grit* has a relationship with academic procrastination. *self-efficacy* and *grit* low increases procrastination tendencies, while *self-efficacy* and *grit* the high lowers it (Martono et al., 2023). On the other hand, academic procrastination itself has a negative impact on mathematical problem-solving ability because procrastination behavior leads to limited time to practice, increases anxiety, and reduces the effectiveness of critical thinking when solving complex problems. Thus, academic procrastination can play a role as an intervening variable in the relationship between *self-efficacy* and *grit* to mathematical problem-solving skills. However, to support a more constructive frame of thinking and lead to the formulation of strategies to improve students' learning abilities, in this study the opposite approach of procrastination is used, namely academic anti-procrastination.

Academic anti-procrastination refers to the ability of individuals to avoid procrastination, demonstrate time discipline, have initiative in completing tasks on time, and organize a planned learning strategy. Thus, in this study, academic anti-procrastination was positioned as a positive variable that favors the achievement of high-level thinking skills, and not simply as the opposite of procrastination, but as a form of behavior that reflects strong academic responsibility and self-management.

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The interconnectedness of the three variables, namely *grit, self-efficacy*, and anti-procrastination, forms a system that supports each other. *Grit* provides psychological endurance, *self-efficacy* provides confidence and direction, and anti-procrastination provides discipline of time and real action. The three form a strong synergy in encouraging students to persevere, be confident, and act disciplined in solving mathematical problems that require perseverance, logical thinking strategies, and resilience to failure. If one of the three factors is weak, then the problem-solving process will be disrupted.

Therefore, it is necessary to conduct more in-depth research to examine the influence of these three variables on students' mathematical problem-solving abilities. This research is expected to provide a more comprehensive picture of the factors that affect mathematics learning outcomes, as well as provide strategic recommendations for teachers and schools, especially high schools in South Kuta, in designing a learning approach that not only focuses on academic aspects, but also strengthens the affective dimension and learning behavior of students.

METHODS

This study uses a quantitative approach with *an ex post facto* explanatory design. The basic nature of *ex post facto* research is non-experimental, where the researcher does not provide treatment or manipulate independent variables, but examines events that have occurred in the subject naturally to uncover causal relationships between variables through structural modeling. This study aims to find out the structural model formed from the relationship between research variables, so this study is included in the type of correlational research because the researcher wants to find out the influence and degree of influence between two variables, thus hypothesis testing is carried out using SEM (*Structural Equation Model*). The use of SEM as a data analysis technique is based on the evaluation of the influence between variables adjusted to the theoretical and conceptual basis of the research.

The affordable population in this study is all grade XI students of State Senior High Schools (SMAN) in South Kuta District, Badung Regency, Bali Province in the 2025/2026 Academic Year spread across three schools, namely SMAN 1 South Kuta, SMAN 2 South Kuta, and SMAN 3 South Kuta with a total population of 721 students. Sampling in this study used *proportional random sampling technique.* Sampling pays attention to the balance or proportion according to the population, by taking into account the existing population. Proportional *random sampling* is carried out randomly with a lottery system that is carried out after determining the minimum sample size needed to represent the population. The minimum sample size used in the study using

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SEM analysis techniques was determined using *the Isaac Michael* formula. The formula is as follows.

$$S = \frac{\lambda^2 NPQ}{d^2(N-1) + \lambda^2 PQ}$$

Description:

S : Lots of Samples
N : A large population
P : true odds (0.5)
Q : Wrong Chance (0.5)
d : difference between sample average and population average (0.05)
λ^2 : chi square obtained by looking at the degree of freedom and the degree of error. In this study, dk = 1 was used and the error rate was 5% so that the chi square value of 3.841 was obtained.

Using *the Isaac Michael* formula, a minimum sample number of 253 respondents was obtained. The sample can be declared representative because most of it already represents the population and the subjects that are sampled are similar to the subjects that are not sampled with the following calculations.

$$S = \frac{(3{,}841)(733)(0{,}5)(0{,}5)}{(0{,}05)^2(733-1) + (3{,}841)(0{,}5)(0{,}5)} = \frac{703{,}863}{2{,}79} \approx 253$$

After knowing the size of the sample, then the number of sample members in each class is determined proportionally with the following formula.

$$\text{Proporsi sampel} = \frac{populasi\ kelas}{total\ populasi} \times besar\ sampel$$

Based on the results of the calculation above, the distribution of sample members is presented as follows.

Table 1: Sample Recapitulation of Each Class

Classes	Populasi	Sample
SMA Negeri 1 South Kuta	264	**91**
SMA Negeri 2 South Kuta	353	**121**
SMA Negeri 3 South Kuta	116	**41**
Total	**733**	**253**

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RESULTS AND DISCUSSION

Respondent Characteristics and Descriptive Data Analysis

This study involved 255 respondents who were Class XI students of State High School in South Kuta District. The demographic profile shows a relatively balanced gender distribution, namely 135 female students (52.9%) and 120 male students (47.1%). Based on the origin of the education unit, the largest data contribution came from SMA Negeri 2 South Kuta with 123 people (48.2%), followed by SMA Negeri 1 South Kuta with 91 people (35.7%), and SMA Negeri 3 Kuta Selatan with 41 people (16.1%). To give an overview of the distribution of data, the raw score of each latent variable is transformed into a standard *T-Score* (ideal mean score = 50 with standard deviation = 10). The results of descriptive statistical analysis are presented in the following Table 2:

Table 2: Results of Descriptive Analysis of Research Variables

Variabel	Minimum	Maximum	Mean	Std. Deviation
Grit	22,85	83,39	49,99	10,02
Self-Efficacy	13,73	78,78	50,00	10,01
Anti-Procrastinasi Academic	16,62	86,55	49,99	10,01
Problem-Solving Capabilities	21,50	60,46	50,00	10,02

1. Evaluation of Measurement Models (*Outer Model*)

Convergent validity, discriminant validity, and construct reliability tests were performed to ensure the reliability of the instrument's psychometric parameters at the level of the main variables. The test results show that the*outer loading*for all latent dimensions are above the required range. This validity is reinforced by the value of*Average Variance Extracted*(AVE) of the four variables that exceed the minimum critical limit, namely . In addition, the entire construct is proven to be free from measurement error bias due to the value of the$\geq 0{,}50$*Composite Reliability*(CR) is well above the threshold of 0.70.

Table 3: Results of the Second Phase Construct Validity and Reliability Test

Variabel	AVE	CR	Remarks

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Grit	0,520	0,896	Valid & Reliable
Self-Efficacy	0,518	0,906	Valid & Reliable
Anti-Procrastinasi Academic	0,525	0,898	Valid & Reliable
Mathematical Problem-Solving Skills	0,556	0,861	Valid & Reliable

2. Evaluation of Structural Models (Inner Model)

Structural model evaluation (*inner model*) was carried out to determine the relationship between latent variables in the research. In this study, *the evaluation of the inner model* was carried out through *testing the fit model*, the value of the determination coefficient (*R-Square*), and hypothesis testing using direct effect and indirect effect analysis. The structural model of the research is presented in the following figure.

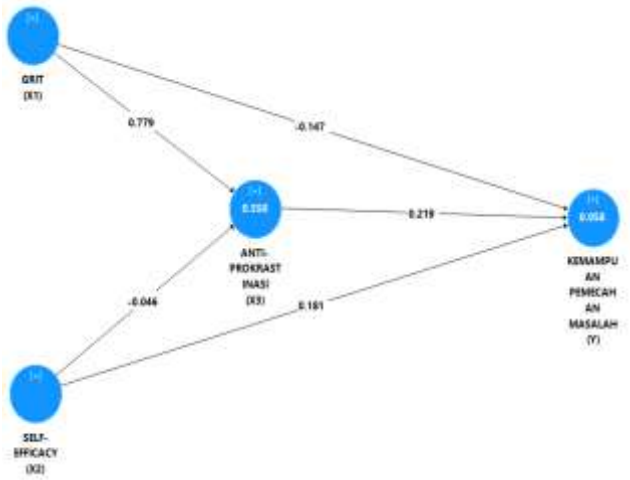


Figure 1: Structural model of research

Model Fit

Testing *Models* FIT was carried out to determine the level of suitability of the research model with the empirical data obtained. In this study, the testing *model fit* done using the *Standardized Root Mean Square Residual* (SRMR). The test results *model fit* using Smart-PLS is presented in Table 4 below.

Table 4: Fit Model Test Results

Fit Model Index	Value	Criteria	Remarks
SRMR	0,087	$SRMR < 0{,}10$	*Acceptable Fit*

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In addition, a test was carried out on the value of the determination coefficient (*R-Square*) is used to measure the ability of exogenous variables to explain endogenous variables in a research model. Value *R-Square* shows how much variation of dependent variables can be explained by independent variables in a constructed structural model. The greater the value *R-Square,* then the greater the ability of exogenous variables to explain endogenous variables. Interpretation of values *R-Square* In this study, it refers to (Hair et al., 2021), i.e. a value of 0.75 indicates a strong model, 0.50 indicates a moderate model, and 0.25 indicates a weak model. Value test results *R-Square* presented in Table 5 below.

Table 5: R-Square Value Test Results

Variable endogenous	*R-Square*	*R-Square Adjusted*	Interpretasi
Anti-Procrastinasi Academic	0,550	0,546	Medium
Mathematical problem-solving skills	0,058	0,047	Weak

Hypothesis Testing (Path Analysis)

Testing of the causality relationship between constructs was carried out through *a bootstrapping procedure* (5000 subsamples) with the parameters of value significance and *p-value*. A summary of the results of the *direct effect* and indirect effect *test results* is presented in Table 6 and Table 7 below:

Table 6: Direct Impact Test Results

Hipotesis	Path Coefficients	*t-statistic*	*p-value*	Verdict
Grit →Anti-Procrastinasis Academic	0,779	10,938	0,000	Accepted
Grit →Mathematical Problem-Solving Ability	−0,147	1,192	0,234	Rejected
Self-Efficacy →Anti-Procrastination Academic	−0,046	0,552	0,581	Rejected
Self-Efficacy →Mathematical Problem Solving Ability	0,181	1,668	0,096	Rejected
Academic Anti-Procrastination	0,219	2,083	0,038	Accepted

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Mathematical Problem Solving Ability →				

Table 7: Indirect Influence Test Results

Mediation Pathway	Path Coefficients	*t-statistic*	*p-value*	Verdict
X1 → X3 → Y	0,170	2,040	0,042	Accepted
X2 → X3 → Y	−0,010	0,479	0,632	Rejected

DISCUSSION

The Influence *of Grit* on Academic Anti-Procrastination

Based on the results of the hypothesis testing, it was obtained that *grit* has a positive and significant effect on the academic anti-procrastination of students. The results of the study show that the higher the *grit* students, the higher the academic anti-procrastination of students. These findings show that students who have perseverance and consistency in achieving goals tend to be better able to avoid procrastinating behaviors of academic work. The results of this study are supported by research Yu et al. (2021) which shows that *math-specific grit* play a role in the mathematics learning process. Students who have *grit* High in mathematics learning tend to be more able to survive difficulties, be more diligent in learning mathematics, and have a lower tendency to procrastinate mathematics. In addition, Yu et al. (2021) found that *grit* In mathematics learning, it is related to the low procrastination of mathematics which ultimately has an impact on mathematics learning outcomes. The findings show that *grit* It is not only related to study perseverance, but also related to the academic behavior of students in completing math tasks consistently without delaying academic work.

Previous research has shown that *grit* plays a role in reducing the level of academic procrastination. Anggerahma & Suryadi (2025) found that *grit* can mediate the relationship between *stress* academics and procrastination, allowing learners to stay motivated to complete tasks despite being under pressure. Similar results were also found in the study Felicia et al. (2025) which confirms that the development of *grit* has the potential to be an effective preventive strategy to reduce procrastination which means that the higher the student's grit, the higher the student's ability to avoid the behavior of procrastinating academic tasks (*anti-procrastinasi academic*).

The results of this study show that students who have high *grit* tend to be able to maintain

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their commitment to learning despite facing difficulties in the mathematics learning process. This can be seen through the *dimensions of grit* used in this study, namely *determination*, *resilience*, and *focus.* The dimension *of determination* shows that students have a strong determination to complete tasks and achieve academic goals. The *focus* dimension shows the ability of students to stay focused on learning goals without being easily distracted, while the *resilience* dimension shows the ability of students to survive and rise when facing difficulties in the learning process.

The Influence *of Grit* on Mathematical Problem-Solving Abilities

Based on the results of the hypothesis testing, it was obtained that *grit* does not have a significant effect on students' mathematical problem-solving ability. Hadil research shows that *grit* has not been able to directly influence students' mathematical problem-solving abilities. The findings show that problem-solving skills are not only influenced by the perseverance and fighting character of students, but are also influenced by various other factors related to cognitive ability, concept mastery, and the mathematics learning process.

Theoretically, *grit* are individual characteristics related to perseverance, consistency of purpose, and the ability to endure difficulties to achieve long-term goals Duckworth et al. (2007). In this study, *grit* measured by dimensions *determination*, *focus,* and *resilience.* These three dimensions theoretically support students to survive in the mathematics learning process which requires consistent effort and practice.

However, the results of the study show that *grit* has not been able to have a direct influence on mathematical problem-solving ability. This finding is indeed different from several theoretical studies in Chapter II which explain that *grit* has the potential to support students' academic success, including in mathematics learning. However, the difference in results does not indicate that *grit* theory contradicts the results of the study, but rather shows that the influence *of grit* on mathematical problem-solving ability tends to be indirect, but through certain learning behavior mechanisms.

This is understandable because mathematical solving skills are complex abilities. In solving mathematical problems, students not only need perseverance and fighting power, but also need an understanding of mathematical concepts, the ability to think logically, the ability to choose the right solution strategy, and the ability to connect various mathematical concepts in the process of solving problems. This is in line with Kurniawan et al. (2022) which explains that mathematical problem-solving skills are closely related to conceptual understanding, logical reasoning, and the ability to use appropriate problem-solving strategies. Therefore, students who have *grit* High does

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not necessarily automatically have high mathematical problem-solving skills if it is not supported by adequate basic mathematical skills.

Research Yu et al. (2021) shows that *math-specific grit* It is more related to students' learning behaviors, such as perseverance and low academic procrastination, than directly to mathematical problem-solving skills. The study explains that the influence of *grit* Mathematical problem-solving skills tend to occur through certain mechanisms of academic behavior during the mathematics learning process.

Thus, the results of this study do not contradict the theory in Chapter II, but rather note that *the grit* on mathematical problem-solving ability tends to be indirect. *Grit* plays a role in shaping students' positive academic behaviors, such as perseverance in learning, consistency in completing assignments, and the ability to avoid academic procrastination. These positive academic behaviors then help students improve their mathematical problem-solving skills.

Therefore, the results of this study actually strengthen the view that the success of students in learning mathematics is not only determined by certain cognitive factors and characters separately, but is the result of the interaction between students' character, academic behavior, and the learning process experienced by students during learning.

The Effect *of Self-Efficacy* on Academic Anti-Procrastination

Based on the results of the hypothesis testing, it was obtained that *self-efficacy* did not have a significant effect on the academic anti-procrastination of students. The results of the study show that *self-efficacy* has not been able to have a direct influence on the academic anti-procrastination of students. These findings show that students' confidence in their abilities does not necessarily directly make students able to avoid the behavior of procrastinating academic work.

Theoretically, *self-efficacy* is an individual's belief in his or her ability to complete tasks or face certain situations. Bandura (1997) That individuals who have *self-efficacy* Tall, tend to be more confident in facing challenges, more optimistic about their abilities, and better able to survive when facing difficulties. In the context of learning, *self-efficacy* It is often associated with students' learning motivation, perseverance, and academic performance.

However, the results of this study show that *self-efficacy* has not been able to have a significant influence on students' academic anti-procrastination. The findings show that belief in one's own abilities is not enough to make students able to avoid the behavior of procrastinating academic assignments. Students may have confidence that they are able to complete math tasks, but still

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procrastinate due to other factors, such as lack of study discipline, poor time management, study habits, or distractions from the surrounding environment.

The findings of this study are different from several previous studies that showed a significant relationship between *self-efficacy* and academic procrastination Putra et al. (2023) found that *self-efficacy* has a negative relationship with academic procrastination, which means it is getting higher *self-efficacy* The lower the tendency of academic procrastination. However, the study also explains that the contribution of *self-efficacy* Against academic procrastination, it is relatively small, which is only 2.16%. These results show that *self-efficacy* is not the main factor that directly determines the academic procrastination behavior of students.

In addition, Putra et al. (2023) It also revealed that there were other studies that found different results, namely the absence of a significant relationship between *self-efficacy* and academic procrastination. The findings suggest that the *self-efficacy* With academic procrastination, it can be influenced by other factors, such as self-regulation, time management, learning discipline, and students' learning habits. The results of this study show that students who are confident in their abilities do not necessarily immediately have disciplined and consistent learning habits. In some conditions, high confidence can actually make students feel able to complete assignments in a short time, so they tend to delay working on academic assignments. This condition causes students' self-confidence to not necessarily be followed by consistent academic behavior.

The Effect *of Self-Efficacy* on Mathematical Problem-Solving Ability

Based on the results of the hypothesis testing, it was obtained that *self-efficacy* does not have a significant effect on students' mathematical problem-solving ability. The results of the study show that *self-efficacy* has not been able to have a direct influence on students' mathematical problem-solving abilities. The findings show that students' confidence in their abilities is not necessarily directly followed by their ability to solve math problems**.**

Theoretically, *self-efficacy* is an individual's belief in his or her ability to complete a certain task. Bandura (1997) explains that individuals who have *self-efficacy* Tall, tend to be more confident in facing challenges and have confidence that they are able to complete tasks well. In the context of learning mathematics, *self-efficacy* It is often associated with the courage of students in facing mathematics problems**,** motivation to learn, as well as perseverance in the learning process. Nevertheless, the results of this study show that *self-efficacy* has not been able to have a direct influence on students' mathematical problem-solving skills. These findings show that belief in

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one's abilities alone is not enough to make students able to solve mathematical problems well. Mathematical problem-solving skills require various other skills, such as understanding mathematical concepts, logical thinking skills, the ability to choose the right solution strategies, and experience in dealing with various forms of mathematical problems. This is in line with Jufri et al. (2025) which explains that mathematical problem-solving skills require conceptual understanding, procedural skills, and the ability to choose the right strategy in solving mathematical problems.

CONCLUSION

Based on the results of the research and discussion, it can be concluded that the relationship model between grit, self-efficacy, academic anti-procrastination, and mathematical problem-solving ability has been proven to be empirically feasible through the fulfillment of the criteria of validity, reliability, and significance of intervariable relationships. This study shows that grit has a positive and significant effect on students' academic anti-procrastination. However, grit does not have a significant direct effect on mathematical problem-solving ability. The results of the study also showed that self-efficacy did not have a significant effect on both academic anti-procrastination and mathematical problem-solving ability. These findings indicate that students' confidence in their abilities has not been able to directly encourage the formation of disciplined learning behaviors or improve mathematical problem-solving skills. Furthermore, academic anti-procrastination has been proven to have a positive and significant effect on students' mathematical problem-solving abilities. This means that the lower the tendency of students to procrastinate on academic assignments, the better their ability to solve mathematical problems. In addition, academic anti-procrastination has also been shown to be able to mediate the influence of grit on mathematical problem-solving skills. Thus, grit can improve mathematical problem-solving skills through the formation of more disciplined academic behavior and avoid procrastination. In contrast, academic anti-procrastination is unable to mediate the influence of self-efficacy on students' mathematical problem-solving abilities.

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