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Correlation of mathematical resilience, attitudes and learning habits, gender and their impact on student academic performance

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Abstract

Students enrolled in Informatics Engineering Education programs frequently encounter substantial obstacles in mastering Discrete Mathematics, a fundamental subject that necessitates perseverance, logical reasoning, and effective study strategies. These challenges are often compounded by negative perceptions of mathematics, lack of perseverance in learning, and ineffective study habits. In this context, it is imperative to investigate non-cognitive factors that may influence students' academic performance (SAP), such as mathematics resilience (MR), attitudes and learning habits (ALH), and gender. This study endeavours to examine the extent to which MR, ALH, and gender contribute to SAP in Discrete Mathematics. A quantitative ex post facto correlational design was employed, involving a sample of 50 third-semester students selected through proportional random sampling methods. Data were collected using standardised questionnaires assessing MR and ALH, along with academic records from the targeted course. The findings indicate that both MR and ALH significantly influence students' academic performance. Among these factors, ALH emerged as the most influential contributor to academic success. In contrast, gender did not have any substantial impact on students' achievement. These results emphasize the significance of non-cognitive factors—particularly resilience and effective learning behaviors—in supporting students' success in mathematics-related coursework.

Keywords: academic performance; attitudes and learning habits; mathematical resilience

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Introduction

Mathematics plays a fundamental role in developing logical and analytical thinking skills, particularly among students pursuing Informatics Engineering. This competency forms the foundation for students to comprehend and resolve intricate computational challenges. However, the pervasive negative perception of mathematics as a challenging and abstract subject continues to pose a significant impediment to learning. Recent studies have revealed that numerous students encounter difficulties in grasping mathematical concepts, which directly correlates with their academic underachievement (Aydın & Erdem, 2023; OECD, 2021). Courses such as Discrete Mathematics, a cornerstone of the Informatics Engineering curriculum, often present challenges due to the in-depth comprehension required of concepts such as set theory, logic, relations, and graphs (Schoenfeld, 2010).

Various studies have demonstrated that students' difficulties in comprehending Discrete Mathematics are primarily attributed to inadequate mastery of fundamental concepts, weak logical reasoning abilities, and the absence of suitable learning strategies. Kusumaningrum and Lestari (2021) revealed that a significant portion of students have not achieved adequate proficiency in Discrete Mathematics, which is evident in the low performance obtained in learning evaluations. Furthermore, Mujib (2019) underscored that the primary challenge lies in the comprehension of mathematical notation and the execution of logical proofs, which are fundamental components of Discrete Mathematics. Additionally, Hanifah and Nawafilah (2021) emphasised that students' difficulties in other mathematics courses, such as Linear Algebra, are closely linked to their lack of motivation for learning and cognitive readiness. These findings underscore the paramount importance of developing innovative and adaptable pedagogical approaches to enhance the effectiveness of mathematics education within the context of higher education, particularly in Informatics Engineering study programs.

Mathematical resilience, which refers to an individual's capacity to endure and recover from difficulties in comprehending or solving mathematical problems, is a crucial factor that aids students in overcoming challenges in learning mathematics (Siagian et al., 2025; Johnston-Wilder et al., 2020). This resilience manifests as a positive attitude towards mathematics, the ability to manage emotions effectively, and perseverance in the face of obstacles (Mazana et al., 2019). Research has demonstrated that mathematical resilience significantly contributes to students' problem-solving abilities and academic achievement (Supriadi et al., 2024; Zhou et al., 2019). Students with high resilience exhibit greater persistence in confronting academic challenges and demonstrate the aptitude to employ alternative strategies in solving mathematical problems. Vergara (2021) underscored the positive correlation between mathematical resilience and achievement goals, emphasising the significance of non-cognitive factors in academic success. Furthermore, a systematic study conducted by Kablan and Uğur (2020) revealed that high mathematical resilience supports problem-solving abilities and enhances students' readiness to confront the challenges of learning mathematics.

Furthermore, mathematical resilience not only plays a role in the cognitive context but is also associated with the emotional and motivational aspects of students' learning. Hakim and Murtafiah (2020) demonstrated that students with high resilience exhibit greater confidence in

solving mathematical problems and can overcome anxiety that often arises during the learning process. Additionally, Vergara (2021) underscored the significance of mathematical resilience in assisting students in confronting learning challenges during the COVID-19 pandemic, where adaptation to online learning was paramount. Azizah (2023) further revealed that mathematical resilience contributed 36% to the mathematics achievement of informatics students, indicating a substantial influence of this factor on academic success. Attami et al. (2020) corroborated the positive correlation between mathematical resilience and mathematical problem-solving abilities among junior high school students, with a contribution of 16.3%. These findings collectively confirm that developing mathematical resilience is a crucial strategy for enhancing the effectiveness of mathematics learning and students' academic success, particularly in addressing dynamic and intricate learning challenges.

In addition to mathematical resilience, students' attitudes and study habits play pivotal roles in determining academic performance, particularly in courses that necessitate logical reasoning and problem-solving abilities (Capuno et al., 2019). Positive attitudes toward mathematics, characterised by beliefs in its relevance and significance to their chosen field of study, can augment intrinsic motivation and active engagement in the learning process (Alemany-Arrebola et al., 2025; Yeribatuah & Arthur, 2023). Dowker and Sheridan (2022) demonstrated a correlation between positive attitudes toward mathematics and improved performance, even after controlling for variables such as mathematical anxiety and working memory capacity. Furthermore, Hernández de la Hera et al. (2023) underscored the association between high mathematics interest and self-concept among first-year college students and a reduced likelihood of dropping out of college, emphasising the significance of affective factors in achieving academic success.

Effective study habits, including effective time management, utilisation of diverse learning resources, and reflective analysis of errors, significantly contribute to students' academic success (Walck-Shannon et al., 2021). A study conducted by Tus (2020) demonstrated that the adoption of good study habits can enhance students' academic performance in logic-based and problem-solving courses, such as mathematics. Furthermore, Sidek et al. (2024) and Hershner (2020) underscored the importance of maintaining good sleep quality and consistency in improving students' academic grades. Notably, poor sleep consistency has been associated with a reduction in academic performance of up to 25%. Walck-Shannon et al. (2021), Svartdal (2021), and Sakirudeen and Sanni (2017) further corroborated these findings, emphasising the positive impact of effective study habits on students' academic success in the Nigerian context. These findings collectively reinforce the significance of cultivating a positive attitude towards mathematics and implementing effective study strategies to enhance students' academic performance.

In the context of Informatics Engineering education, a solid foundation in mathematical concepts is crucial for developing technical skills, such as programming, algorithm analysis, and data processing. Courses such as Discrete Mathematics play a pivotal role in fostering logical and abstract thinking skills essential for this field. However, research specifically investigating the correlation between mathematical resilience and academic performance among Informatics Engineering students is still in its infancy. Most previous studies have

concentrated on the influence of digital-based learning strategies on the learning outcomes of Informatics Engineering students (Rustanuarsi, 2022). Notably, a study by Akkan and Horzum (2024) underscores the significance of mathematical resilience in mathematics education, yet it does not explicitly explore its implications in Informatics Engineering. Furthermore, research conducted by Xenofontos and Mouroutsou (2022) demonstrated a positive correlation between mathematical resilience and academic performance. However, further research is warranted to elucidate these dynamics in the specific context of Informatics Engineering.

In addition, this study provides a comprehensive analysis of the role of gender in relation to students' academic performance. This research is significant because conflicting findings and perspectives exist regarding the impact of gender on academic success. For instance, Gil (2024) revealed that in women, several psychological resilience factors correlated with academic achievement, whereas in men, there was no discernible correlation between psychological resilience and academic performance. This finding suggests the influence of gender role. Conversely, Siagian et al. (2025) and Amoado et al. (2024) argued that gender did not identify a statistically significantly influence academic resilience or well-being.

Consequently, this study seeks to address this gap by investigating the correlation between mathematical resilience, attitudes and learning habits, gender, and academic performance of Informatics Engineering students. Academic performance will be evaluated based on the grades obtained in Discrete Mathematics courses, which are regarded as indicative of the aptitude to comprehend mathematical concepts within this domain. Therefore, the anticipated outcomes of this study will provide novel insights into the factors that contribute to the academic success of Informatics Engineering students. Furthermore, the findings of this study can serve as a reference for educators and educational institutions in devising more effective learning strategies to enhance students' academic resilience, as suggested by Akkan and Horzum (2024) in their study on the significance of fostering resilience in mathematics education.

Methods

This study employed a quantitative approach with an ex post facto correlational design. This design was deemed appropriate as it permitted the researchers to examine the relationships between the independent and dependent variables without manipulating any of them, thereby preserving the inherent characteristics of the data (Creswell, 2014; Rohwer, 2021). The utilisation of this design is particularly suitable for educational research, where variables such as psychological attributes and academic performance cannot be ethically or practically manipulated (Fraenkel et al., 2012).

The research was conducted at a private university in North Sumatra, Indonesia, and involved students enrolled in the Informatics Engineering Education Study Program. The study population consisted of third-semester students, from whom a sample of up to 50 students was selected using a proportional random sampling method. The sample comprised 26 male and 24 female students. The sample size was determined using the Slovin formula with a 5% margin of error to ensure sample representativeness.

Data were collected using three primary instruments: (1) an MR questionnaire, (2) a questionnaire assessing ALH, and (3) documentation of students' grades in the Discrete Mathematics course. The MR instrument encompassed indicators such as persistence in problem-solving, the capacity to overcome learning difficulties, and flexibility in identifying alternative solutions. The ALH instrument measures aspects including students' perceptions of mathematics, time management, study strategies, and participation in academic discussions.

Prior to the primary analysis, all instruments underwent validation and reliability testing. Validity was assessed using Pearson's product-moment correlation, and reliability was measured using Cronbach's alpha coefficient. The validity test results demonstrated that the correlation coefficient (r) for each item ranged from 0.45 to 0.79 for MR and 0.51 to 0.751 for ALH, with a significance value (p-value) below 0.05. This indicates that all items in the instrument exhibited a positive and statistically significant correlation with the total score, suggesting their empirical validity and suitability for research data collection. The reliability coefficient for the MR questionnaire was 0.75, while that for the ALH questionnaire was 0.812. Both reliability coefficients were within the high range, indicating a reasonably high consistency of the instrument. These procedures ensured that the instruments consistently measured the intended constructs, adhering to the standard practices in quantitative research (Chan & Idris, 2017).

Following the verification of the instruments' validity and reliability, a classical assumption test was conducted to assess the feasibility of the data for inferential analyses. The primary data analysis encompassed correlation and multiple regression analyses. Correlation analysis elucidated the strength and direction of the association between mathematical resilience and academic performance. Conversely, multiple regression was employed to assess the combined impact of mathematical resilience, attitudes, and learning habits on academic achievement. This analytical approach is widely adopted in educational research to model the influence of multiple predictors on the learning outcomes (Barrera, 2024).In this study, data processing was conducted using JASP software version 0.19.1 (Apple Silicon). This software was selected because of its user-friendly interface and comprehensive support for parametric and non-parametric statistical analyses, ensuring efficient and transparent execution.

Results

The anticipated research outcomes are centered around the initial research objectives, which are to elucidate the impact of mathematical resilience (MR), attitudes and learning habits (ALH), as well as gender, on student academic performance (SAP). Based on the data collection results, a comprehensive description of the research data characteristics is presented in Table 1.

Table 1. Data description for each variable

Variable	N (Valid)	Mean	Std. Deviation	Minimum	Maximum
MR	50	81.70	6.437	70	95
ALH	50	82.30	9.379	60	95
SAP	50	87.70	8.331	63	99

Based on Table 1, it is evident that the "MR" score ranges from 70 to 95, suggesting that most respondents possess a relatively high level of resilience. The average "MR" value is 81.70, with a standard deviation of 6.437. This value is smaller than the "ALH" variable, indicating a more uniform distribution of "MR" values. For "ALH", the minimum value is 60, while the maximum is 95, indicating that the majority of participants fall within the medium to high score range in terms of "ALH". The average "ALH" score of respondents was 82.30, with a standard deviation of 9.379. This value suggests a moderate variation in the data distribution. Additionally, the "SAP" range spans from 63 to 99, indicating variation in performance among respondents. However, the average tended to be higher. The description of data acquisition for each variable based on gender is presented in Table 2.

Table 2. Data description based on gender

Gender	Variabel	N (Valid)	Mean	Std. Deviation	Minimum	Maximum
Male	MR	26	80.58	6.217	70	90
	ALH	26	80.39	10.29	60	95
	SAP	26	85.85	9.743	63	99
Female	MR	24	82.92	6.58	70	95
	ALH	24	84.38	7.983	70	95
	SAP	24	89.7	6.05	76	99

The dataset in Table 2 presents the descriptive statistics for three variables—MR, ALH, and SAP—stratified by gender. For males (N = 26), the mean scores were 80.58 (SD = 6.22) for MR, 80.39 (SD = 10.29) for ALH, and 85.85 (SD = 9.74) for SAP. Female participants (N = 24) exhibited slightly higher means: 82.92 (SD = 6.58) for MR, 84.38 (SD = 7.98) for ALH, and 89.70 (SD = 6.05) for SAP.

The score ranges (minimum–maximum) for males spanned 70–90 (MR), 60–95 (ALH), and 63–99 (SAP), while females showed comparable ranges: 70–95 (MR), 70–95 (ALH), and 76–99 (SAP). Notably, females demonstrated marginally higher average performance across all variables, with lower variability in ALH and SAP scores than males.

Prior to conducting the multiple linear regression analysis, classical assumption tests, including the normality, homoscedasticity, multicollinearity, and autocorrelation tests, were performed to ascertain that the data adhered to the analysis prerequisites. A normality test was conducted by examining the residual distribution. This is evidenced by the residual histogram presented in Figure 1.

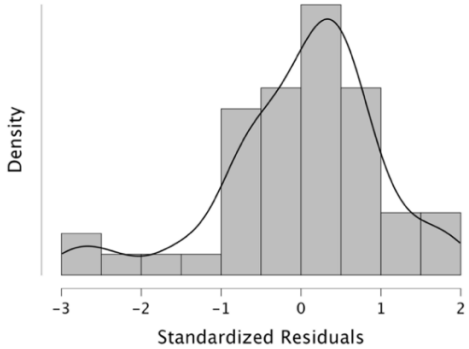

Figure 1. Residual histogram

Figure 1 presents a residual histogram, which is a visual tool that assesses the normality of the residuals. The histogram illustrates the frequency distribution of the residual values across distinct intervals. Visually, the residuals appear to form a bell-shaped curve, with the highest frequency concentrated at the centre (residual values near zero) and a symmetrical decline in frequency toward both sides. There were no discernible signs of extreme deviations (outliers) or substantial skewness in the distribution. Based on this visual evidence, it can be concluded that the residuals exhibit a distribution that closely approximates normality. Consequently, the normality assumption was satisfied. This implies that the regression model employed is likely to yield unbiased and efficient parameter estimates, thereby supporting the validity of the subsequent hypothesis testing.

Following the assessment of residual normality, the subsequent step in the multiple linear regression analysis involved verifying the assumption of homoscedasticity. This assumption stipulates that the variance of the residuals remains constant across all levels of the predicted values. A violation of this assumption (heteroscedasticity) can result in inefficient parameter estimates and potentially misleading results.

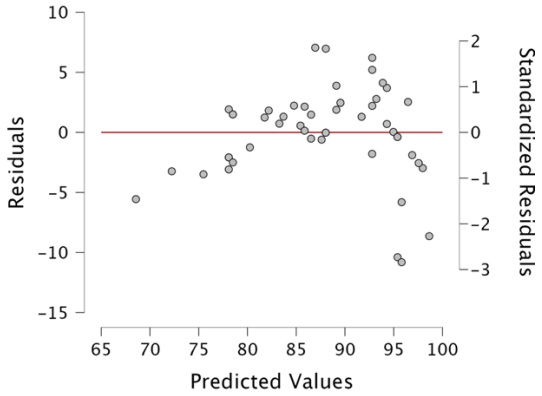

Figure 2. Residuals vs. Predicted

Figure 2 presents a scatter plot of the residuals against the predicted values, which functions as a diagnostic tool for identifying non-constant variance. In this plot, the residuals are uniformly distributed around the horizontal axis (residual = 0). The residuals exhibited random dispersion, lacking a discernible pattern, such as a fan shape, curvature, or systematic trend.

This uniform distribution of residuals suggests that the variance remained relatively constant throughout the range of predicted values. Consequently, the assumption of homoscedasticity was met, which supports the robustness of the regression model and enhances the reliability of its parameter interpretations.

Furthermore, multicollinearity was assessed using Tolerance and Variance Inflation Factor (VIF) values. The test results are listed in Table 3.

Table 3. Results of classical multicollinearity assumptions

Variable	Tolerance	VIF
MR	0.925	1.081
ALH	0.913	1.095
Gender	0.935	1.069

As shown in Table 3, all variables exhibit a tolerance value exceeding 0.1 and a Variance Inflation Factor (VIF) less than 10. Consequently, it can be definitively concluded that there is no multicollinearity among independent variables. Concurrently, an autocorrelation test was conducted by examining the Durbin-Watson value. The Durbin-Watson value obtained is 1.851, approaching the value of 2, suggesting the absence of autocorrelation in the residuals. The p-value was not provided. value = 0.556. This reinforces the conclusion that autocorrelation is insignificant.

Subsequently, after verifying that the data adhered to the classical assumptions, multiple linear regression analysis was conducted to ascertain the impact of MR, ALH, and Gender on the dependent variable SAP. A concise summary of the model derived from the outcomes of multiple linear regression testing is presented in Table 4.

Table 4. Model summary

Model	R	R^2	Adjusted R^2	Std. Error of Estimate	Durbin-Watson
1	0.890	0.791	0.778	3.928	1.851

As shown in Table 4, the coefficient of determination (R^2) value of 0.791 suggests that 79.1% of the variance in the dependent variable can be attributed to the independent variable. Furthermore, the adjusted R^2 value of 0.778 indicates that the model's predictive power remained robust even after accounting for the additional variables. Furthermore, to ascertain whether all independent variables (MR, ALH, Gender) collectively exert a significant influence on the dependent variable (SAP), a simultaneous significance test (F Test) was conducted. The outcomes of the simultaneous significance test (F Test) are presented in Table 5.

Table 5. Simultaneous significance test (F test)

Source	JK	df	RJK	F	Sig.
Regression	2690.849	3	896.950	58.141	< 0.001
Residual	709.651	46	15.427		
Total	3400.500	49			

As shown in Table 5, the F-value is 58.141, and the p-value is less than 0.001. This indicates that MR, ALH, and Gender collectively have a statistically significant impact on the dependent variable SAP. Finally, to ascertain whether each independent variable, individually or partially, exerts a significant impact on the dependent variable, a partial significance test (t-test) was conducted. The test results are listed in Table 6.

Table 6. Partial significance test (T-test)

Variable	B	Std. Error	Beta	t	Sig.
(Constant)	8.833	7.882	—	1.121	0.268
MR	0.217	0.091	0.167	2.391	0.021
ALH	0.736	0.063	0.828	11.750	<0.001
Gender	0.420	1.150	0.025	0.365	0.717

As shown in Table 6, a regression model was constructed to predict student academic performance (SAP) in terms of the variables MR, ALH, and gender. The regression analysis

revealed that the MR variable had a statistically significant impact on SAP (B = 0.217, SE = 0.091, β = 0.167, t = 2.391, p = 0.021). This indicates that a one-unit increase in the MR score is associated with an average increase in the SAP score of 0.217 points after controlling for other variables. Therefore, MR is also a positive predictor, although with a smaller influence strength than ALH. Furthermore, the ALH variable also significantly influenced SAP achievement (B = 0.736, SE = 0.063, β = 0.828, t = 11.750, p = 0.001). This indicates that a one-unit increase in attitude score is associated with an average increase in SAP score of 0.736 points after controlling for other variables. In contrast, gender did not have a significant effect on SAP (B = 0.420, SE = 1.150, β = 0.025, t = 0.365, p = 0.717); thus, gender differences were not significantly correlated with SAP achievement in this model. Overall, this model emphasises that MR and ALH are important factors that can affect SAP in the context of discrete mathematics, with ALH being the strongest predictor.

Discussion

The findings of this study offer significant contributions to the understanding of the dynamics of students' internal factors influencing their academic achievement in learning discrete mathematics. Regression analysis indicated that mathematical resilience (MR) and attitudes and learning habits (ALH) were substantial predictors of student academic performance (SAP), whereas gender did not significantly contribute to the predictive model.

The significance of mathematical resilience in academic performance

Mathematical resilience, as elucidated by Johnston-Wilder et al. (2013), encompasses an individual's ability to endure, adapt, and sustain motivation in the face of obstacles encountered during the mathematics learning process. Within the context of this study, the positive impact of MR on SAP implies that students who can manage frustration, persist, and maintain their engagement in learning mathematics tend to exhibit superior academic performance. This finding aligns with the growth mindset approach, which posits the significance of cultivating the belief that abilities can be developed through dedicated effort and effective learning methods (He et al., 2023; Zhang et al., 2017).

The findings of this study corroborate the significance of Mathematical Resilience (MR) in determining Student Academic Performance (SAP) (Akkan & Horzum, 2024; Sharma Chapai et al., 2024; Nabdel et al., 2023; Vergara, 2021; Fatimah & Purba, 2021). This aligns with a study conducted by Azizah (2023), which demonstrated a robust correlation between mathematical resilience and student achievement in the Informatics study program's Numerical Analysis course. Furthermore, Rustanuarsi (2022) elucidated the substantial impact of mathematical resilience on student learning outcomes in the Analytical Geometry course. Zanthy (2018) further corroborated these findings, highlighting the positive impact of good mathematical resilience on students' academic achievement in logic-based and problem-solving courses such as mathematical statistics.

Furthermore, several studies have demonstrated that mathematical resilience substantially influences students' problem-solving abilities. Students with high resilience can solve problems

through effective interpretation, strategic thinking, and proficiency in arithmetic operations. Fitriani et al. (2023), Laelasari et al. (2022), and 'Athiyah et al. (2020) provide empirical evidence supporting this assertion. Additionally, Santosa et al. (2023) conducted research suggesting that mathematical resilience contributes to students' problem-solving abilities, with gender serving as a moderating variable. In a distinct context, Murni et al. (2021) elucidated that mathematical resilience, in conjunction with students' perceptions of online lectures, simultaneously and partially influences students' mathematical strengths, which encompass critical thinking and problem-solving abilities.

These findings reinforce the position of MR as a strategically affective factor in mathematics learning, particularly in complex materials such as discrete mathematics, which frequently necessitate persistence and tolerance for temporary setbacks. Within this framework, MR serves not only as a psychological safeguard but also as a cognitive catalyst that enables students to persist in the learning process until they achieve their goals.

Attitudes and learning habits: The primary predictors of academic performance

The attitudes and learning habits (ALH) variable emerged as the most significant predictor in the model, exhibiting the highest regression coefficient among all the independent variables. This observation indicates that positive attitudes toward mathematics learning, coupled with consistent and strategic learning practices, are the primary determinants of academic performance.

Wang and Chen (2025), Firdousi et al. (2024), and Hashim et al. (2021) provide evidence for this. A study conducted by Ferinaldi and Rais (2020) revealed a close correlation between students' learning habits and their mathematical problem-solving abilities. In the context of Informatics Engineering education, this finding reinforces the argument that learning strategies that foster positive attitudes and regular learning habits can enhance students' academic performance, particularly in problem-solving-oriented courses such as discrete mathematics. Mutya et al. (2023) also found a positive correlation between students' attitudes and learning habits and their academic performance in science, although this correlation was not statistically significant. However, research suggests that personality traits, including attitudes and study habits, may be more robust predictors of academic success than IQ (Dings & Spinath, 2021; McCann et al., 2020; Bergold & Steinmayr, 2018; Poropat, 2014).

According to the theory of self-regulated learning, students who possess metacognitive awareness, intrinsic motivation, and effective study habits tend to achieve higher academic outcomes (Brenner, 2022). In this context, ALH encompasses the cognitive and affective dimensions of active learners who not only comprehend the significance of learning but also demonstrate the ability to manage their time, establish goals, and independently assess their progress.

These findings underscore the importance of reinforcing learning attitudes and habits through pedagogical interventions, such as training in self-regulated learning skills, project-based learning, or the utilisation of educational technology that fosters active participation and self-reflection.

Insignificance of the effect of gender

Despite numerous previous studies demonstrating gender-based disparities in learning achievement, this study failed to establish a substantial impact of gender on the SAP. This outcome suggests that, in the context of discrete mathematics learning within this population, equitable access and learning opportunities have been achieved, thereby eliminating significant performance differences between boys and girls.

This interpretation aligns with the gender-neutrality approach to academic performance, which posits that an inclusive, adaptive, and equitable learning environment minimises gender-based disparities (Reynoldset al., 2015; Hyde, 2014). Similarly, numerous studies have reinforced the notion that gender is not a primary factor in disparities in academic proficiency, particularly in mathematics. Studies conducted by Siagian et al. (2025), Bohrnstedt et al. (2024), Mozahem et al. (2020), and Rodríguez et al. (2020) consistently demonstrated that gender-related differences do not substantially impact academic achievement, including in the domain of mathematics. Furthermore, this finding may reflect the success of a learning approach that emphasises individual potential rather than social or cultural stereotypes.

Conclusion

Attitudes and learning habits (ALH) and mathematical resilience (MR) significantly influence students' academic performance (SAP) in discrete mathematics, with ALH emerging as the strongest predictor. In contrast, gender was found to have no significant effect, suggesting that academic achievement is more strongly shaped by psychological and behavioural factors than by demographic characteristics.

These findings highlight the importance of learning approaches that nurture positive attitudes, consistent study habits, and students' ability to persist in the face of academic challenges. Nevertheless, this study is subject to several limitations, including a relatively small sample size, a cross-sectional research design, and a limited set of variables. Future research should employ longitudinal or mixed-method approaches with more diverse populations to enhance generalisability. Practically, these results suggest the need for structured educational programs that foster both self-discipline and resilience in learning mathematics, contributing to a more holistic and inclusive strategy for improving higher-education outcomes.

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Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this manuscript. In addition, the authors have completed the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies.

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Author Contributions

Ade Evi Fatimah: Conceptualization, writing - original draft, editing, and visualization; **Muhammad Daut Siagian:** Writing - review & editing, formal analysis, and methodology; **Rini Sulastri:** review, editing, and formal analysis.

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