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# Academic Self-Efficacy, Achievement Motivation, and Academic Resilience as Predictors of Science Learning Outcomes among Students in the Elementary School Teacher Education Programme

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**Abstract:** Science learning outcomes among elementary school teacher education students are determined not only by mastery of content but also by psychological factors that influence engagement, persistence, and academic success. This study aimed to analyse the effects of academic self-efficacy, achievement motivation, and academic resilience on the science learning outcomes of students in the Elementary School Teacher Education Programme. The study employed a quantitative approach with a correlational survey design. The respondents comprised 136 students. Data were collected through a four-point Likert-scale questionnaire, with 16 items for each variable, and were then analysed using multiple linear regression. Instrument quality indicated that all items were valid and reliable, with Cronbach's alpha values of 0.951 for academic self-efficacy, 0.953 for achievement motivation, 0.962 for academic resilience, and 0.979 for science learning outcomes. The findings showed that the three predictors simultaneously had a significant effect on science learning outcomes with $R = 0.909$, $R^2 = 0.826$, and $F(3,132) = 209.460$, $p < 0.001$. Partially, academic self-efficacy had a significant positive effect, academic resilience emerged as the most dominant predictor, whereas achievement motivation had no significant effect after being controlled together with the other variables. These findings underscore that improving the science learning outcomes of Elementary School Teacher Education students should focus on strengthening academic confidence and learning resilience through challenging, supportive, and sustainable learning experiences.

**Keywords:** Learning outcomes; Motivation; Resilience; Science; Self-efficacy

## Introduction

Learning outcomes in higher education are increasingly understood as the result of an interaction between cognitive ability and psychological factors that shape students' engagement in learning. In the current research landscape, academic self-efficacy has emerged as an important predictor because it strengthens engagement and sustains the quality of students' academic performance (Meng & Zhang, 2023). Other studies have extended this landscape by showing that non-cognitive variables, such as growth mindset, grit, and self-efficacy, operate simultaneously in explaining student achievement in higher education contexts (Correa-Rojas et al., 2024). At the same time, academic resilience has also been identified as an important mechanism linking learning support resources with better academic performance (Cai & Meng, 2025). However, a clear research gap remains in that the integration of three psychological predictors—academic self-efficacy, achievement motivation, and academic resilience—has rarely been tested simultaneously in the context of science learning outcomes among prospective elementary school teachers. Therefore, this study

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departs from the need to position academic success as a multidimensional outcome that cannot be explained by a single construct alone.

In elementary school teacher education, science learning occupies a strategic position because it requires not only conceptual mastery but also readiness among prospective teachers to teach science confidently, reflectively, and adaptively. Several recent studies on pre-service teachers have shown that science self-efficacy and authentic learning experiences develop through diverse sources of experience, including field practice, technology integration, and structured teaching experiences (Hammack et al., 2024). Increased science self-efficacy has also been reported when elementary education students engage in garden-based and technology-supported learning experiences that provide space for direct practice and meaningful feedback (Ingram et al., 2024). On the other hand, changes in self-efficacy among prospective science teachers during teaching practice indicate that contextual factors strongly determine the stability of students' professional and academic beliefs (Yerdelen et al., 2024). However, most of these studies focus on teaching self-efficacy or practicum contexts, rather than on science learning outcomes as direct academic outcomes within the Elementary School Teacher Education Programme. This condition highlights the need to remap psychological factors that are more closely related to the academic performance of prospective teachers.

Recent research on science learning also shows that instructional design can change students' perceptions of their own ability and their learning outcomes. In flipped classroom settings for pre-service teachers, variations in self-efficacy, motivation, and learning satisfaction have been shown to relate to differences in learning achievement in modern educational technology courses (Zhao et al., 2021). Other findings indicate that STEM models and self-efficacy contribute to student learning outcomes, suggesting that academic success is determined not only by course content but also by students' beliefs in their capacity to complete academic tasks (Awaludin et al., 2023). In the context of elementary science learning, discovery learning can even transform self-efficacy through direct learning experiences, social support, and presentation opportunities that strengthen students' academic confidence (Ilyas et al., 2025). Nevertheless, this research map is still dominated by short-term intervention studies and thus has not sufficiently explained how psychological constructs operate as simultaneous predictors of variation in science learning outcomes in regular lecture settings. This gap makes predictive analysis both relevant and urgent.

In addition to self-efficacy, achievement motivation continues to be positioned as an important driver of student success, but recent empirical evidence suggests that its influence is often indirect. Achievement motivation can enhance students' performance and readiness through self-efficacy and academic achievement that develop in sequence, rather than solely through an independent direct effect (Li et al., 2022). In the context of online learning, academic self-efficacy has even been shown to mediate the relationship between academic motivation and students' academic achievement, indicating that motivation works through a mechanism of self-belief before it is translated into actual performance (Shofiah et al., 2023). More recent findings further show that achievement motivation is intertwined with satisfaction with one's major and successful intelligence in supporting the sustainability of higher education (Alismail & Almulla, 2026). Thus, the theoretical gap that remains open lies in the uncertain position of achievement motivation when it is tested together with academic self-efficacy and academic resilience as predictors of learning outcomes. For this reason, the simultaneous testing of these three variables is important to obtain a sharper and more operational model.

Over the past five years, academic resilience has developed from being merely a protective construct into an important lens for understanding how students continue to persist, function, and achieve under demanding academic conditions. Research on university students has shown that resilience is associated with learning resources, self-efficacy, engagement, and well-being, making its position increasingly central in explaining the quality of student learning outcomes (Bagdžiūnienė et al., 2025). Other studies strengthen this finding by showing that resilience contributes to well-being through grit and motivation, meaning that academic endurance cannot be separated from the motivational processes that sustain continued learning effort (Obeng et al., 2025). Even in different socio-cultural contexts, resilience is still understood as an adaptive capacity that helps students cope with academic pressure and maintain academic achievement (Lehihi et al., 2025). However, most studies on resilience still position it alongside well-being, grit, or social support, rather than as part of a predictive model specifically directed at the science learning outcomes of prospective elementary school teachers. Therefore, this study is needed to bring resilience to the centre of discussion on academic performance in subject-specific learning.

At the same time, recent studies on academic self-efficacy indicate that learning context factors, such as digital competence, learning approaches, and

engagement, help determine how students' self-beliefs are translated into learning outcomes. Academic self-efficacy correlates with students' digital competence, suggesting that the ability to manage modern learning resources can strengthen their academic readiness (Javier-Aliaga et al., 2024). Other studies show that self-efficacy is related to the learning approaches students choose, indicating that the quality of learning strategies may mediate the strength of psychological constructs in influencing performance (Laitinen et al., 2024). Meanwhile, student engagement has also been shown to be associated with self-efficacy in more complex psychological models in higher education contexts (Wang & Zhang, 2024). Based on this research map, the present study was conducted to answer the following question: to what extent do academic self-efficacy, achievement motivation, and academic resilience simultaneously and partially affect the science learning outcomes of Elementary School Teacher Education students? By employing multiple regression, this study is expected to provide an empirical contribution that is more contextual, measurable, and relevant for strengthening science learning in elementary teacher education.

## Method

*Research Design*

This study used a quantitative design with a correlational-explanatory survey approach to examine the simultaneous and partial effects of three predictors on one dependent variable. All data were collected cross-sectionally within a single measurement period without any experimental treatment. The independent variables consisted of academic self-efficacy (X1), achievement motivation (X2), and academic resilience (X3), while the dependent variable was the science learning outcomes of students in the Elementary School Teacher Education Programme (Y). This design was selected because it allows the estimation of the strength of relationships among constructs as well as the magnitude of each predictor's contribution within a multiple linear regression model.

*Participants and Sampling Technique*

The target population comprised active students of the Elementary School Teacher Education Programme at Universitas Negeri Yogyakarta. Purposive sampling was applied using a priori eligibility criteria, namely: (a) being an active student, (b) being enrolled in semesters 1–8, (c) having a cumulative grade point average of ≥ 2.50, and (d) willingness to complete the questionnaire in full.

A total of 136 students met these criteria and were included in the analysis. Recruitment was conducted through class coordination and written notices. Participation was voluntary and uncompensated after participants had received a clear explanation of the study objectives and procedures. Based on respondents' identity data, the participants consisted of 24 male students (17.6%) and 112 female students (82.4%), aged 17–25 years (M = 19.10, SD = 1.22). Most respondents were in semester 2, followed by semesters 1, 6, and 8.

*Variables and Instruments*

All constructs were measured using a closed-ended questionnaire with a four-point Likert scale, namely 4 = very appropriate, 3 = appropriate, 2 = inappropriate, and 1 = very inappropriate. Each variable consisted of 16 items, resulting in a total of 64 items with a theoretical score range of 16–64 for each construct.

Academic self-efficacy (X1) was measured through 16 items representing students' beliefs in their ability to understand science concepts, complete assignments, and achieve academic targets. Achievement motivation (X2) was measured through 16 items describing achievement orientation, goal setting, the tendency to choose challenging tasks, and the drive to improve academic performance. Academic resilience (X3) was measured through 16 items reflecting the ability to recover from difficulties, manage criticism, sustain learning engagement, and formulate steps for academic improvement. Science learning outcomes (Y) were measured through 16 items representing the ability to understand concepts, relate concepts to context, draw conclusions, and evaluate simple scientific information.

*Instrument Validity and Reliability*

Item validity was tested using Pearson product moment correlations between each item score and the corrected total score within the same construct. With N = 136 (df = 134) at a two-tailed significance level of 0.05, the r_table value was 0.168. The test results showed that all 64 items were valid. The r_count values ranged from 0.575–0.810 for academic self-efficacy, 0.610–0.804 for achievement motivation, 0.717–0.816 for academic resilience, and 0.757–0.913 for science learning outcomes. All coefficients exceeded the r_table value, and therefore no items were eliminated.

The internal consistency of the instrument was tested using Cronbach's alpha. The results indicated excellent reliability, namely 0.951 for academic self-efficacy, 0.953 for achievement motivation, 0.962 for academic resilience, and 0.979 for science learning outcomes. All alpha values exceeded the minimum threshold of 0.70, indicating that the instrument was reliable for further analysis.

*Data Analysis Technique*

The analysis began with descriptive statistics to obtain the minimum, maximum, total score, mean, and standard deviation for each variable. Before hypothesis testing, classical assumption tests were conducted, including tests of residual normality, multicollinearity, and heteroscedasticity. Residual normality was evaluated using the Kolmogorov–Smirnov test, multicollinearity was assessed through tolerance values and variance inflation factors (VIF), whereas heteroscedasticity was tested using the Glejser approach. The main hypotheses were tested using multiple linear regression to assess simultaneous effects through the F-test and partial effects through the t-test at a 5% significance level.

## Result and Discussion

*Result*

*Instrument Validity and Reliability Tests*

Before estimating the regression model, the quality of the instrument was tested. The product moment validity test showed that all items across the four variables met the validity criteria. With r_table = 0.168, all items on academic self-efficacy, achievement motivation, academic resilience, and science learning outcomes had r_count values above this critical value. Therefore, all 64 items were deemed suitable for use in the analysis.

The reliability test results also showed very high internal consistency. Cronbach's alpha values of 0.951 for academic self-efficacy, 0.953 for achievement motivation, 0.962 for academic resilience, and 0.979 for science learning outcomes confirmed that the instrument had very good measurement stability. Based on these findings, all total variable scores were used in the stages of classical assumption testing and multiple regression.

*Classical Assumption Tests*

The residual normality test using the Kolmogorov–Smirnov test produced a statistic of 0.150 with a significance value of 0.004. This value was lower than 0.05, indicating that the model residuals were not fully normally distributed. Nevertheless, the regression analysis was continued with caution because the sample size was relatively adequate and the main objective of the study was to estimate the direction and magnitude of relationships among variables.

The multicollinearity test showed that all predictors remained within acceptable limits. The tolerance values for academic self-efficacy, achievement motivation, and academic resilience were 0.258, 0.177, and 0.193, respectively, whereas the VIF values were 3.873, 5.637, and 5.194. Since all tolerance values were > 0.10 and all VIF values were < 10, the model did not show problematic multicollinearity.

The Glejser heteroscedasticity test produced a model significance value of 0.021. Partially, the significance values were 0.018 for academic self-efficacy, 0.014 for achievement motivation, and 0.252 for academic resilience. These findings indicate the presence of heteroscedasticity in the model, and therefore the interpretation of the regression coefficients was undertaken with caution.

*Descriptive Statistics*

Descriptive analysis was conducted to describe the general tendencies and score distributions of each construct in N = 136. Achievement motivation had the highest mean (M = 51.04, SD = 7.56), followed by academic resilience (M = 50.49, SD = 7.81), academic self-efficacy (M = 50.49, SD = 7.47), and science learning outcomes (M = 49.68, SD = 8.45). The empirical score ranges for each variable were 29–64 for X1, 31–64 for X2, 29–64 for X3, and 16–64 for Y. This pattern indicates that the three predictors were at relatively similar mean levels, whereas the science learning outcomes variable had the largest score dispersion.

**Tabel 1.** Descriptive statistics (N = 136)

| Variable | Min | Max | Sum | Mean | Std. Dev |
|---|---|---|---|---|---|
| Academic Self-Efficacy (X1) | 29.00 | 64.00 | 6866.00 | 50.49 | 7.47 |
| Achievement Motivation (X2) | 31.00 | 64.00 | 6941.00 | 51.04 | 7.56 |
| Academic Resilience (X3) | 29.00 | 64.00 | 6867.00 | 50.49 | 7.81 |
| Science Learning Outcomes (Y) | 16.00 | 64.00 | 6757.00 | 49.68 | 8.45 |

*Model Summary*

The multiple linear regression results showed a very strong relationship between the three predictors and science learning outcomes. The multiple correlation coefficient was R = 0.909, with a coefficient of determination of $R^2$ = 0.826. This means that 82.6% of the variation in science learning outcomes could be jointly explained by academic self-efficacy, achievement motivation, and academic resilience. After adjustment for the number of predictors, the Adjusted $R^2$ value was 0.822. The standard error of the estimate of 3.559 indicates that the average deviation of the actual scores from the model's predicted scores was relatively small on the 16–64 scale.

**Table 2.** Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | 0.909 | 0.826 | 0.822 | 3.559 |

*Model ANOVA*

The F-test showed that the regression model was simultaneously significant, F (3, 132) = 209.460, p < 0.001. Thus, the null hypothesis stating that all regression coefficients are equal to zero was rejected. The magnitude of the regression sum of squares (SSR = 7961.068) compared with the residual sum of squares (SSE = 1672.336) indicates that most of the variation in the dependent variable could be explained by the model.

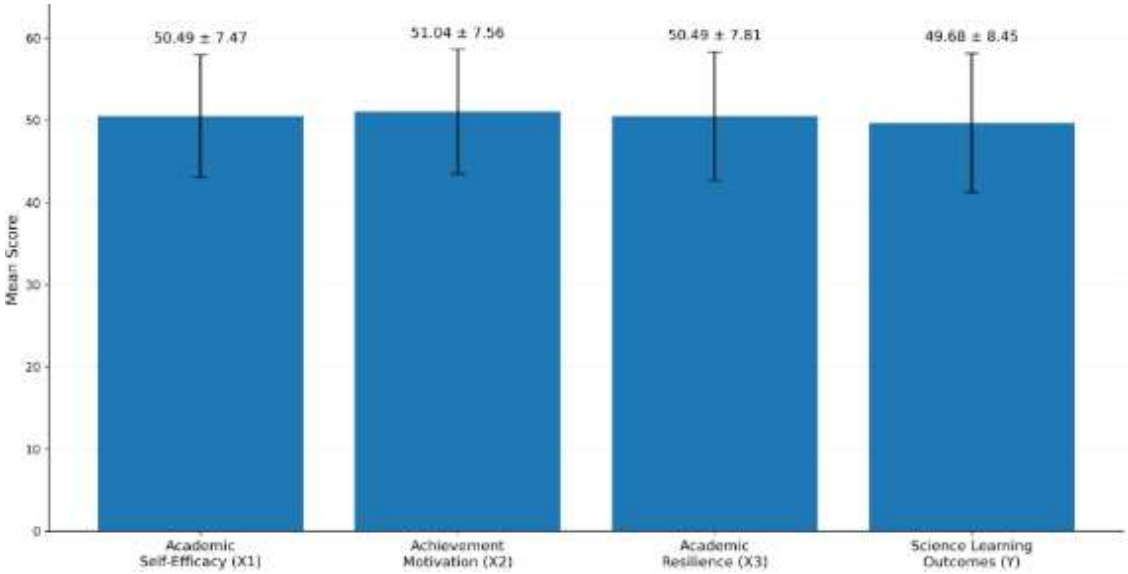


**Figure 1.** Descriptive Statistics: Means with Standard Deviations

**Table 3.** ANOVA

| Source | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 7961.068 | 3 | 2653.689 | 209.460 | 0.000 |
| Residual | 1672.336 | 132 | 12.669 | | |
| Total | 9633.404 | 135 | | | |

*Model Coefficients*

The partial test results showed that academic resilience was the strongest predictor of science learning outcomes. Its regression coefficient was B = 0.840 with β = 0.777, t = 9.407, and p < 0.001. Academic self-efficacy also had a positive and significant effect on science learning outcomes (B = 0.226, β = 0.200, t = 2.801, p = 0.006). In contrast, achievement motivation had a very small negative coefficient and was not significant (B = -0.051, β = -0.045, t = -0.525, p = 0.600).

The model constant of -1.585 was not significant (p = 0.469). Based on the unstandardised coefficients, the resulting regression equation was:

$$Y = -1.585 + 0.226X1 - 0.051X2 + 0.840X3 \quad (1)$$

This equation indicates that increases in academic self-efficacy and academic resilience tended to be followed by increases in science learning outcomes, whereas achievement motivation did not show a meaningful partial contribution after being controlled together with the other predictors.

**Table 4.** Regression Coefficients

| Predictor | B | Std. Error | Beta | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | -1.585 | 2.181 | — | -0.727 | 0.469 |
| Academic Self-Efficacy (X1) | 0.226 | 0.081 | 0.200 | 2.801 | 0.006 |
| Achievement Motivation (X2) | -0.051 | 0.096 | -0.045 | -0.525 | 0.600 |
| Academic Resilience (X3) | 0.840 | 0.089 | 0.777 | 9.407 | 0.000 |

*Discussion*

The main finding of this study shows that academic self-efficacy, achievement motivation, and academic resilience simultaneously explain a very large proportion of variance in the science learning outcomes of Elementary School Teacher Education students. The strength of this model is consistent with studies positioning self-efficacy as a driver of academic engagement and performance, while academic resilience strengthens students' capacity to remain productive when facing high learning demands (Meng & Zhang, 2023). This result is also consistent with evidence showing that academic performance in higher education is an outcome of the interaction between internal resources and environmental support, rather than the result of a single psychological factor (Cai & Meng, 2025). In addition, non-cognitive models integrating growth mindset, grit, and academic self-efficacy have been shown to explain student achievement meaningfully in higher education contexts (Correa-Rojas et al., 2024). Thus, science learning outcomes among prospective teachers are more appropriately understood as the cumulative result of confidence, perseverance, and achievement energy that intertwine throughout a complex learning process.

Partially, academic self-efficacy had a positive and significant effect on science learning outcomes. This finding is important because it confirms that students' belief in their ability to complete tasks, understand concepts, and endure academic evaluation remains a psychological mechanism directly associated with learning outcomes. Recent studies show that self-efficacy influences achievement not only through internal drive but also through more adaptive goal orientation when students face complex academic demands (Liu et al., 2026). In medical education contexts, self-efficacy has also been shown to mediate the relationship between professional identity and academic performance, such that students with higher confidence in their competence tend to demonstrate more stable performance (G. Zhang, 2025). Even in digital environments, academic self-efficacy correlates with students' readiness to manage new learning demands and utilise learning resources more effectively (Javier-Aliaga et al., 2024). Therefore, strengthening self-efficacy deserves to be positioned as a psychopedagogical foundation for improving science learning mastery more sustainably in this Elementary School Teacher Education context.

Academic resilience emerged as the strongest predictor in the model, both in terms of unstandardised coefficients and standardised beta. The dominant role of this variable suggests that students' science learning outcomes are determined not only by feeling capable but, more importantly, by the ability to persist, recover, and remain directed when facing learning difficulties. Recent studies show that student resilience grows from a combination of personal and study-related resources, then contributes to engagement and psychological well-being that support academic performance (Bagdžiūnienė et al., 2025). Other findings confirm that resilience is associated with academic well-being through the mechanisms of grit and motivation, so resilient students tend to maintain their learning focus for longer periods (Obeng et al., 2025). Even across different socio-cultural contexts, resilience continues to be understood as an adaptive capacity that increases the likelihood of students persisting and succeeding in higher education (Lehihi et al., 2025). Thus, academic resilience appears to function as a regulatory force that keeps students moving forward when science learning demands become difficult, abstract, and exhausting.

In contrast to the other two predictors, achievement motivation did not show a significant partial effect after academic self-efficacy and academic resilience were entered together into the model. This pattern does not necessarily negate the importance of motivation but instead suggests that its influence may operate indirectly through competence beliefs, persistence, or learning regulation mechanisms. In research on university students, achievement motivation has been shown to enhance academic performance as well as self-efficacy, such that both often move along interconnected psychological pathways (Li et al., 2022). Other studies also show that academic motivation can improve achievement through the mediating role of self-efficacy, rather than always through an independent direct effect (Shofiah et al., 2023). In broader higher education contexts, achievement motivation is also related to satisfaction with one's major and successful intelligence, so its effect may weaken when more proximal psychological variables are controlled (Alismail & Almulla, 2026). Therefore, motivation appears to function as a driving force that requires efficacy and resilience to be translated into actual learning performance.

Descriptive statistics showed that the meanings of the three predictors were relatively similar, whereas science learning outcomes had the widest score distribution. This pattern suggests that students generally already possess adequate psychological resources, but that their translation into academic performance has not yet been evenly realised. In science learning, high self-efficacy usually develops when students are confronted with authentic and challenging tasks that provide opportunities to try out and verify ideas (Ilyas et al., 2025). This finding aligns with research showing that STEM learning models and self-efficacy

contribute to learning outcomes, indicating that achievement is determined not only by course content but also by students' perceptions of their own capability during learning (Awaludin et al., 2023). On the other hand, the learning approaches perceived by students are related to self-efficacy, indicating that the quality of learning strategies determines how self-belief is translated into performance (Laitinen et al., 2024). This means that improving science learning outcomes requires lecture designs that foster successful experiences, reflection, and well-directed learning strategies.

Although the regression model demonstrated a strong fit, the findings from the classical assumption tests require careful interpretation. Residuals that were not fully normal and indications of heteroscedasticity suggest that relationships among psychological variables are not always perfectly linear, because they are very likely influenced by differences in coping strategies, academic pressure, and variations in individual learning experiences. Recent literature shows that self-efficacy is closely related to learning engagement, but this relationship can vary depending on students' professional commitment and psychological conditions (Wang & Zhang, 2024). Other studies indicate that self-efficacy is also related to academic stress through coping style, such that students' responses to learning demands may generate non-homogeneous data distribution patterns (Sun et al., 2025). Even at more advanced study levels, perceived pressure can affect engagement through the serial roles of social support and academic self-efficacy (J. Zhang et al., 2026). Therefore, the findings of this study are strong substantively, but their technical interpretation should be accompanied by methodological caution and an awareness of the complexity of student learning behaviour.

Practically, the findings of this study direct intervention towards strengthening the psychological factors most proximal to performance, particularly academic self-efficacy and academic resilience. Intervention should not stop at the provision of verbal encouragement but needs to be embodied in learning experiences that make students feel capable, autonomous, and persistent when dealing with challenging science material. Recent studies show that self-efficacy can serve as an important mediator linking self-directed learning competence with lifelong learning tendencies, so strengthening efficacy may produce long-term impacts on graduate quality (Akçay, 2025). In addition, findings on the roles of academic hardiness, passion, and self-efficacy indicate that learning success is influenced by a combination of endurance and academic confidence (Zhou et al., 2025). Other studies confirm that self-efficacy is intertwined with the value and cost students perceive when preparing for their future and career (Zhi & Han, 2026). Thus, the development of science learning in Elementary School Teacher Education should better organise tasks, feedback, and assessment in ways that build enduring confidence in learning.

## Conclusion

This study confirms that academic self-efficacy, achievement motivation, and academic resilience simultaneously constitute very strong predictors of the science learning outcomes of students in the Elementary School Teacher Education Programme. At the partial level, academic self-efficacy and academic resilience were shown to have significant positive effects, whereas achievement motivation did not have a significant direct effect after being controlled together with the other predictors. Academic resilience emerged as the most dominant predictor, indicating that success in science learning among prospective teachers depends heavily on their ability to persist, adapt, and remain directed in the face of academic demands. Substantively, these findings reinforce the importance of instructional design that not only delivers content but also builds self-confidence, learning resilience, and repeated experiences of academic success. Nevertheless, the findings from the classical assumption tests indicate the need for caution in the technical interpretation of the model, and therefore future studies are recommended to employ more robust designs and a broader range of accompanying variables.

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**Author Contributions**
A. H: conceptualization, methodology, instrument development, supervision, writing–original draft, and interpretation of results. H. S: data curation, formal analysis, validation, literature review, writing–review and editing. Both authors read and approved the final manuscript.

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**Conflicts of Interest**
The authors declare that there is no conflict of interest.

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