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AI Literacy, Self-Efficacy, and Statistics Anxiety of Prospective Mathematics Teachers: A Correlational Study in Educational Statistics Learning

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ABSTRACT

The development of artificial intelligence (AI) requires prospective mathematics teachers not only to master statistical concepts but also to be able to use, evaluate, and critically leverage AI in learning. However, AI use does not always correspond to lower statistics anxiety, because students must still understand concepts, verify answers, and take academic responsibility. This study analyzed the relationship and the effect of AI literacy and statistics self-efficacy on the statistics anxiety of prospective mathematics teachers in an Educational Statistics course. It used a correlational quantitative approach with 124 students of the Mathematics Education (Tadris Matematika) Study Program. The instruments were AI literacy, statistics self-efficacy, and statistics anxiety scales of 12 items each. Data were analyzed using descriptive statistics, validity and reliability tests, Pearson correlation, regression assumption tests, and multiple linear regression. AI literacy was in the high category (M = 49.24; SD = 8.12), statistics self-efficacy was high (M = 48.16; SD = 8.30), and statistics anxiety was moderate (M = 40.95; SD = 10.79). The regression model was significant simultaneously (F = 7.090; p = 0.001) with R^2 = 0.105. Partially, AI literacy had a significant positive effect on statistics anxiety (B = 0.578; β = 0.435; p < 0.001), whereas statistics self-efficacy had a significant negative effect when controlling for AI literacy (B = −0.333; β = −0.256; p = 0.030). These findings suggest that AI literacy among prospective mathematics teachers can increase critical awareness as well as evaluative burden in learning statistics, while self-efficacy acts as a protective factor against anxiety once the effect of AI literacy is controlled. The implications emphasize Educational Statistics instruction using AI that not only trains technological skills but also builds self-efficacy, critical literacy, and regulation of academic anxiety.

Keywords: AI Literacy; Statistics Self-Efficacy; Statistics Anxiety; Prospective Mathematics Teachers; Educational Statistics.

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1. INTRODUCTION

The development of artificial intelligence (AI) has changed the higher education learning ecosystem, including the learning of mathematics and statistics. AI is no longer understood merely as an additional technology; it has become part of students' everyday learning practices. Students can use AI to look for explanations of concepts, create practice problems, check solution steps, interpret data, and obtain feedback more quickly. For prospective mathematics teachers, this change has strategic meaning because students are not only users of technology but also future

educators who must be able to select, adapt, and integrate technology pedagogically. Therefore, AI literacy has become an important competence in Educational Statistics learning.

AI literacy can be understood as the ability to comprehend basic AI concepts, use AI-based systems, evaluate AI outputs, and consider the ethical aspects, accuracy, and responsibility of their use. Ng et al. (2021) identified four dimensions of AI literacy, namely the ability to know and understand AI, use and apply AI, evaluate and create AI, and consider AI ethics. Ayanwale et al. (2024) showed that AI literacy among pre-service teachers is important because future classrooms are increasingly digitalized and require teachers to be conceptually and practically ready to use AI. In mathematics and statistics learning, AI literacy has the potential to help students connect abstract concepts with concrete examples, but it also requires students not to accept AI results passively. AI literacy is therefore related not only to the ease of completing tasks but also to the ability to evaluate and the responsibility to use technology. These characteristics allow students with better AI literacy to be more aware of the limitations of AI and the complexity of statistical analysis, so that the use of AI is not always followed by a reduction in statistics anxiety.

The integration of AI into mathematics education also presents opportunities and challenges. Anwari & Nuriadin (2025) explained that AI can increase the personalization of learning, the effectiveness of the learning process, and learner engagement. Maryati et al. (2026) showed that generative AI-based adaptive learning can improve the statistical literacy and TPACK of prospective mathematics teachers through structured prompting, dialogic interaction, and lecturer scaffolding. However, the use of AI does not always guarantee independent mastery of concepts. This is reinforced by Bastani et al. (2025), who found that students using GPT-4 without pedagogical safeguards improved their practice scores by 48% but obtained exam scores 17% lower than the control group when AI was no longer available. Meanwhile, Hanan & Sugiman (2025) showed that the use of AI has the potential to affect learners' beliefs about mathematics, both through improved learning outcomes and cognitive abilities. These findings confirm that the benefits of AI depend on the strategy of use, so conceptual understanding and critical evaluation are needed to ensure that AI does not create dependence but instead supports the development of students' statistical literacy and independent thinking. Thus, AI literacy needs to be examined not only as a technological ability but also as a variable related to students' psychological aspects.

In addition to being influenced by integration strategies and students' ability to use AI critically, the success of AI use in statistics learning is also related to psychological factors, particularly students' belief in their own ability to understand and complete statistical tasks. This is important because AI use can provide a different learning experience for each student, both in increasing confidence and in forming dependence on technological assistance. One psychological aspect that is highly relevant in statistics learning is self-efficacy. Self-efficacy refers to an individual's belief in their ability to complete tasks, overcome difficulties, and achieve certain academic results. In the Educational Statistics course, self-efficacy appears in students' belief that they can understand concepts, use formulas, process data, read the output of statistical applications, and interpret analysis results. Lim (2023) found that self-efficacy plays a role in shaping prospective teachers' perceptions of AI-based education. Meegan & Young (2025) also showed that a generative AI intervention can improve the self-efficacy and AI literacy of prospective teachers when AI is positioned as a tool rather than a substitute for the thinking process. In other words, self-efficacy is a bridge between technological ability, learning experience, and students' readiness to face statistical tasks.

On the other hand, statistics anxiety remains an important problem in statistics learning in higher education. Statistics anxiety arises when students feel afraid, tense, doubtful, or not

confident when dealing with numbers, formulas, analysis procedures, statistical software, and the interpretation of results. Kaufmann et al. (2022) showed that self-efficacy is related to statistics anxiety, in that students who feel capable tend to have lower anxiety. Mendes et al. (2025), in a systematic review, confirmed that psychological interventions in statistics learning are generally aimed at reducing anxiety, increasing self-efficacy, and building positive attitudes toward statistics. Dodeen et al. (2025) also showed that statistics anxiety, attitudes toward statistics, and self-efficacy are psychological factors related to students' academic achievement. Thus, statistics anxiety needs to be understood as a psychological phenomenon that cannot be resolved merely by adding material or computation practice.

Among prospective mathematics teachers, the issue of statistics anxiety is more complex. They are prepared to teach mathematics and statistics to learners, so unmanaged anxiety can affect their professional identity, teaching readiness, and pedagogical beliefs. Yanti et al. (2025) showed that mathematics anxiety and self-efficacy are related to the performance of prospective mathematics teachers. Uygun & Baş (2026) also found that anxiety can play a role in the relationship between attitudes toward mathematics teaching and prospective teachers' self-efficacy beliefs. These findings show that prospective teachers need not only to master content but also to be psychologically ready to learn and teach mathematics confidently.

The gap addressed by this study lies in the limited research that simultaneously links AI literacy, statistics self-efficacy, and statistics anxiety among prospective mathematics teachers in the context of Educational Statistics learning. Previous research on AI in mathematics education has mostly highlighted the potential of AI integration, the readiness of prospective teachers, digital literacy, or the effectiveness of AI-based learning. Meanwhile, research on statistics anxiety and self-efficacy has generally still focused on students in general, social science students, or statistics course contexts, without positioning AI literacy as a variable that helps shape students' psychological experience. Yet, in current learning situations, students increasingly use AI when doing statistics assignments, studying concepts, and checking data analysis output.

The novelty of this study is that it positions AI literacy as a psychopedagogical factor tested together with statistics self-efficacy to explain the statistics anxiety of prospective mathematics teachers. This study asks not only whether students are able to use AI but also how AI literacy is related to anxiety when students face statistical tasks. By including self-efficacy in the regression model, the study also provides an understanding of whether students' self-belief can act as a protective factor after the effect of AI literacy is controlled. The contribution of this study lies in developing a more balanced discourse on AI-based Educational Statistics learning: adaptive to technology, yet sensitive to students' academic anxiety and self-belief.

Based on the above description, this study aims to analyze the relationship and the effect of AI literacy and statistics self-efficacy on the statistics anxiety of prospective mathematics teachers. Specifically, it examines the relationships among variables, the feasibility of the regression model, the partial contributions of AI literacy and self-efficacy, and the variable that is most dominant in explaining statistics anxiety. The results are expected to serve as a basis for developing Educational Statistics learning strategies that systematically combine AI literacy, the building of self-efficacy, and the management of statistics anxiety.

2. METHODS

This study used a quantitative approach with a correlational type of research. The correlational design was chosen because the study aimed to determine the relationships among AI literacy, statistics self-efficacy, and statistics anxiety without giving any treatment to the

respondents. The study also used multiple linear regression analysis to determine the contribution of AI literacy and statistics self-efficacy in explaining the variation in the statistics anxiety of prospective mathematics teachers.

The respondents were 124 students of the Mathematics Education (Tadris Matematika) Study Program who had taken or were taking the Educational Statistics course. Respondents were selected based on the relevance of their academic experience to the research variables, namely the use of AI technology in the learning process, self-belief in understanding statistical material, and the possible emergence of anxiety when facing tasks, formulas, statistical applications, and data interpretation. The number of 124 respondents was considered adequate for correlation analysis and multiple linear regression with two independent variables.

The research variables consisted of AI Literacy as the first independent variable (X_1), Statistics Self-Efficacy as the second independent variable (X_2), and Statistics Anxiety as the dependent variable (Y). AI literacy was defined as students' ability to understand, use, evaluate, and consider the ethical aspects of AI use in learning. Statistics self-efficacy was defined as students' belief in their ability to understand concepts, solve problems, process data, use statistical applications, and interpret analysis results. Statistics anxiety was defined as feelings of worry, fear, tension, or lack of confidence when students deal with numbers, formulas, analysis procedures, statistical software, assignments, examinations, and the interpretation of statistical results.

The research instruments consisted of three scales, namely an AI literacy scale, a statistics self-efficacy scale, and a statistics anxiety scale. Each scale consisted of 12 items, so the total number of items was 36. The instruments were developed in the form of closed statements and were analyzed through validity and reliability tests. The validity test results showed that all items had correlation coefficients that met the validity criterion, with correlation scores ranging from 0.494 to 0.826. The reliability results showed Cronbach's alpha values in the very good category, namely above 0.9.

The data analysis techniques included descriptive statistics, Pearson correlation, regression assumption tests, and multiple linear regression. Descriptive statistics were used to describe the mean, standard deviation, and category of each variable. Pearson correlation was used to determine the relationships among variables. Before the regression was carried out, the data were tested through a residual normality test, a heteroscedasticity test, a multicollinearity test, and an autocorrelation check using the Durbin-Watson statistic. The regression model tested was $Y = a + b_1X_1 + b_2X_2 + e$, with Y as statistics anxiety, X_1 as AI literacy, and X_2 as statistics self-efficacy.

3. RESULT AND DISCUSSION

3.1 Data Description

The descriptive statistics of the research variables are presented in Table 1.

Table 1. Descriptive Statistics of the Research Variables

Variable	N	Mean	Std. Deviation	Category
AI Literacy (X_1)	124	49.2419	8.12541	High
Statistics Self-Efficacy (X_2)	124	48.1613	8.29868	High
Statistics Anxiety (Y)	124	40.9516	10.78681	Moderate

The descriptive results show that students' AI literacy had a mean of 49.2419 with a standard deviation of 8.12541. This value is in the high category, which means that prospective mathematics teachers already have a positive tendency to understand and use AI to support

learning. This condition is in line with the current change in students' learning practices, in which AI is used to obtain additional explanations, practice problems, feedback, and help with data exploration. However, the high category of AI literacy should not be interpreted merely as operational skill. Referring to Ng et al. (2021), good AI literacy also includes the ability to evaluate AI outputs, understand the limitations of AI, and consider ethical aspects. Therefore, students with high AI literacy should ideally be able not only to use AI but also to critique the answers it produces.

Students' statistics self-efficacy was also in the high category, with a mean of 48.1613 and a standard deviation of 8.29868. This finding shows that students in general have fairly good self-belief in following Educational Statistics learning. Students feel able to understand concepts, complete tasks, process data, read analysis results, and meet academic demands in the statistics course. High self-efficacy is an important asset because statistics learning demands perseverance, the courage to try, and the ability to correct mistakes. This is in line with Kaufmann et al. (2022), who position self-efficacy as an important factor in understanding students' experiences when learning statistics.

Statistics anxiety had a mean of 40.9516 with a standard deviation of 10.78681 and was in the moderate category. This means that, even though students' AI literacy and self-efficacy are high, their anxiety about statistics is not yet fully low. This anxiety arises when students face material, tasks, or learning situations related to statistics. Cruise et al. (1985), through the development of the Statistical Anxiety Rating Scale (STARS), identified several dimensions of statistics anxiety, including anxiety about performing calculations, interpreting statistical results, facing examinations and lectures, and fear of asking for help when experiencing difficulties. This finding is reinforced by Wu et al. (2022), who showed that anxiety about lectures and examinations and low perceived ability to perform calculations had a significant negative effect on students' achievement in statistics courses. This finding shows that technological readiness and self-belief do not automatically eliminate anxiety. From a learning perspective, statistics anxiety is contextual and can change with learning experience, the stage of the course, and the type of task students face, as shown by Oktaviani & Tarma (2026).

3.2 Instrument Validity and Reliability

The results of the validity and reliability tests are presented in Table 2 and Table 3.

Table 2. Results of the Instrument Validity Test

Variable	Number of Items	Range of Correlation Coefficients	Remarks
AI Literacy	12	0.494 – 0.779	Valid
Statistics Self-Efficacy	12	0.686 – 0.806	Valid
Statistics Anxiety	12	0.688 – 0.826	Valid

Table 3. Results of the Instrument Reliability Test

Variable	Number of Items	Cronbach's Alpha	Remarks
AI Literacy	12	0.908	Very good reliability
Statistics Self-Efficacy	12	0.927	Very good reliability
Statistics Anxiety	12	0.937	Very good reliability

The validity test results show that all items in the three instruments met the validity criterion. The ranges of item correlation coefficients were 0.494 to 0.779 for AI literacy, 0.686 to 0.806 for statistics self-efficacy, and 0.688 to 0.826 for statistics anxiety. Thus, all items are able to represent the constructs being measured. Instrument validity is important because this study links latent psychopedagogical variables. If items were not valid, the relationships among variables could be biased and the interpretation of the regression model would be weak.

The Cronbach's alpha values of the three variables were above 0.90, namely 0.908 for AI literacy, 0.927 for statistics self-efficacy, and 0.937 for statistics anxiety. These values indicate very good internal consistency. High reliability indicates that the items in each scale have measurement stability and point to the same construct. In the context of educational research, strong reliability provides a basis for the view that differences in respondents' scores are more likely to reflect variation in respondents' characteristics than random error in the instrument.

3.3 Correlations Among Variables

The results of the Pearson correlation test among the variables are presented in Table 4.

Table 4. Results of the Pearson Correlation Test Among Variables

Relationship Between Variables	Pearson r	Sig. (1-tailed)	Remarks
AI Literacy (X_1) – Statistics Anxiety (Y)	0.263	0.002	Significant
Statistics Self-Efficacy (X_2) – Statistics Anxiety (Y)	0.037	0.341	Not significant
AI Literacy (X_1) – Statistics Self-Efficacy (X_2)	0.673	0.000	Significant

The correlation results show that AI literacy has a significant positive relationship with statistics anxiety ($r = 0.263$; $p = 0.002$). The strength of the relationship is in the weak category, but the positive direction is an interesting finding. In general, technological literacy is often assumed to reduce learning difficulties because students have access to supporting tools. This finding indicates that students with higher AI literacy tend to show higher statistics anxiety as well. The relationship can be understood through the characteristics of AI literacy, which emphasizes not only technical ability in using technology but also the ability to critically evaluate AI results and to understand the limitations and ethical aspects of its use. Students who have a better understanding of AI may be more aware that the calculations and statistical interpretations produced by AI still require verification. This awareness can create additional demands when students must ensure the accuracy of statistical analysis. Students who understand how AI works and its limitations may become more aware that AI output is not always correct, needs to be verified, and must be aligned with valid statistical procedures. This awareness can increase the evaluative burden when students work on statistical tasks.

The positive relationship between AI literacy and statistics anxiety also needs to be understood in the context of the characteristics of students as prospective mathematics teachers. In this context, students are required not only to be able to solve statistical problems but also to prepare themselves to explain statistical concepts and procedures accurately to learners. These demands mean that the ability to use AI needs to be accompanied by the responsibility to check the accuracy of information, understand the solution process, and ensure the accuracy of the interpretation of analysis results. In line with this, Ayanwale et al. (2024) showed that AI literacy among prospective teachers is related to readiness for future classrooms. This readiness brings new demands: prospective teachers must be able to explain the reasons for using AI, assess the

accuracy of information, and maintain academic integrity. Therefore, AI literacy can add to a sense of responsibility and caution in learning statistics. In this situation, anxiety does not always signify weakness but may reflect increased critical awareness of the complexity of AI-based statistical tasks.

Statistics self-efficacy had no significant bivariate relationship with statistics anxiety ($r = 0.037$; $p = 0.341$). This finding differs from the general tendency in the literature showing a negative relationship between self-efficacy and statistics anxiety. Kaufmann et al. (2022), for example, showed that self-efficacy correlates negatively with statistics anxiety and positively with statistics performance. The difference in results in this study suggests that the statistics anxiety of Mathematics Education students is probably not determined by self-belief alone. Other factors such as previous learning experience, the characteristics of statistical tasks, the use of applications, grade pressure, perceptions of formulas, and the demand to verify AI results may also shape anxiety.

The correlation between AI literacy and statistics self-efficacy was strong and significant ($r = 0.673$; $p < 0.001$). This means that students with higher AI literacy tend to have higher self-belief in learning statistics. This finding is in line with Lim (2023), who positions digital literacy and self-efficacy as important factors in prospective teachers' perceptions of AI education. Meegan & Young (2025) also affirmed that AI can increase self-efficacy when it is positioned as a learning aid that expands opportunities for exploration rather than as a shortcut. In the context of this study, AI can help students obtain alternative explanations, check analysis steps, and understand statistical output, so that their self-belief increases.

3.4 Regression Assumption Tests

A summary of the regression assumption tests is presented in Table 5.

Table 5. Summary of the Regression Assumption Tests

Assumption	Indicator/Method	Result	Decision
Residual normality	Kolmogorov-Smirnov	Asymp. Sig. = 0.200; Monte Carlo Sig. = 0.813	Residuals are normally distributed
Heteroscedasticity	Glejser test/ANOVA abs_res	F = 2.171; Sig. = 0.118	No heteroscedasticity
Partial heteroscedasticity	abs_res coefficients	X_1 p = 0.458; X_2 p = 0.350	Not significant
Multicollinearity	Tolerance and VIF	Tolerance = 0.547; VIF = 1.830	No serious multicollinearity
Autocorrelation	Durbin-Watson	1.903	No problematic indication of autocorrelation

Before the regression results were interpreted, the model was tested against several basic assumptions. The residual normality test showed a Kolmogorov-Smirnov Asymp. Sig. of 0.200 and a Monte Carlo Sig. of 0.813. These values are greater than 0.05, so the residuals can be declared normally distributed. Residual normality is important because linear regression assumes that prediction errors are distributed reasonably around the regression line. With this assumption met, the significance tests of the regression coefficients can be interpreted more appropriately.

The heteroscedasticity test, using a model of the absolute residual values, showed a simultaneous significance value of 0.118. Partially, the significance value was 0.458 for AI literacy

and 0.350 for statistics self-efficacy. All values are greater than 0.05, so there is no indication of heteroscedasticity. Thus, the residual variance of the model tends to be constant across levels of the predictors. The absence of heteroscedasticity indicates that the model does not show an error pattern that systematically grows or shrinks as AI literacy or self-efficacy increases.

The multicollinearity test showed a tolerance value of 0.547 and a VIF of 1.830 for both independent variables. The tolerance value is above 0.10 and the VIF is far below 10, so there is no serious multicollinearity. This is important because AI literacy and self-efficacy have a fairly strong correlation. A strong correlation between independent variables can affect the stability of the coefficients, but a VIF of 1.830 shows that the relationship is still within acceptable limits. A Durbin-Watson value of 1.903 also shows no disturbing indication of autocorrelation. Overall, the model meets the basic regression assumptions, so the interpretation of the multiple linear regression results can proceed.

3.5 Multiple Linear Regression Results

The regression model summary, the simultaneous test, and the partial test of the regression coefficients are presented in Table 6, Table 7, and Table 8, and the resulting model is illustrated in Figure 1.

Table 6. Regression Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
0.324	0.105	0.090	10.28939	1.903

Table 7. Results of the Simultaneous Test (ANOVA)

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Regression	1501.260	2	750.630	7.090	0.001
Residual	12810.450	121	105.871	-	-
Total	14311.710	123	-	-	-

Table 8. Results of the Partial Test of the Regression Coefficients

Predictor	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
Constant	28.518	6.094	-	4.680	< 0.001	-	-
AI Literacy (X_1)	0.578	0.154	0.435	3.741	< 0.001	0.547	1.830
Statistics Self-Efficacy (X_2)	−0.333	0.151	−0.256	−2.199	0.030	0.547	1.830

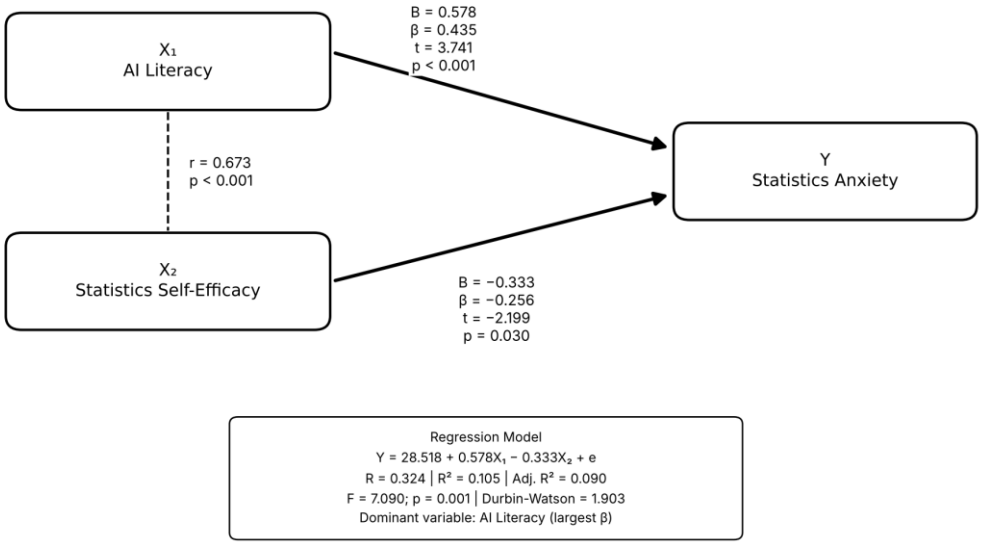


Figure 1. Regression Model of AI Literacy and Statistics Self-Efficacy on Statistics Anxiety

The multiple linear regression results show an R of 0.324, an R Square of 0.105, and an Adjusted R Square of 0.090. An R Square of 0.105 means that AI literacy and statistics self-efficacy together explain 10.5% of the variation in students' statistics anxiety. The remaining 89.5% is explained by other factors outside the research model. This contribution can be categorized as relatively small, but it is still meaningful in educational research that examines psychological variables. Statistics anxiety is a multidimensional phenomenon influenced by learning experience, mathematics history, perceptions of the lecturer, academic pressure, learning strategies, social support, readiness to use software, and the assessment context. Therefore, an R Square of 10.5% does not mean that the model is unimportant; rather, it shows that AI literacy and self-efficacy are only some of the psychopedagogical factors that explain statistics anxiety.

The simultaneous test yielded F = 7.090 with a significance of 0.001. This value is smaller than 0.05, so the regression model is declared significant. This means that AI literacy and statistics self-efficacy together affect students' statistics anxiety. This finding strengthens the argument that statistics anxiety needs to be analyzed through a combination of technological and psychological factors. In present-day Educational Statistics learning, students not only face statistical material conventionally but also face new demands in the form of AI use, information verification, and decision-making about technology-based analysis results. Therefore, a model that combines AI literacy and self-efficacy fits the reality of current learning better than a model that treats anxiety merely as a problem of computational ability.

The resulting regression equation is $Y = 28.518 + 0.578X_1 - 0.333X_2 + e$. This equation shows that, when statistics self-efficacy is controlled, a one-unit increase in AI literacy is followed by a 0.578-unit increase in statistics anxiety. Conversely, when AI literacy is controlled, a one-unit increase in statistics self-efficacy is followed by a 0.333-unit decrease in statistics anxiety. These coefficients show that the two variables have different directions of effect on statistics anxiety. AI literacy acts as a positive predictor, whereas statistics self-efficacy acts as a negative predictor.

Partially, AI literacy has a significant positive effect on statistics anxiety, with B = 0.578, β = 0.435, t = 3.741, and $p < 0.001$. The standardized beta of 0.435 is the largest absolute value in the model, so AI literacy is the dominant variable in explaining statistics anxiety. This finding differs from the simple assumption that the higher the AI literacy, the lower the learning anxiety. Among prospective mathematics teachers, high AI literacy seems not only to provide ease of learning but

also to raise awareness of the complexity of AI use. Students who are more AI-literate may better understand the risks of incorrect answers, bias, the limitations of machine reasoning, and the importance of conceptual validation. This awareness can give rise to evaluative anxiety, especially when students must ensure that AI-assisted statistical solutions remain correct in concept and procedure.

This interpretation is in line with the AI literacy framework put forward by Ng et al. (2021). AI literacy includes cognitive and ethical dimensions, so literate students not only use AI but also question the quality and implications of its use. In statistics, small errors in choosing a test, reading output, or interpreting significance can change the conclusions of a study. Therefore, students who increasingly understand AI may become more careful and feel an additional burden to check the correctness of results. This explains why AI literacy can be positively associated with statistics anxiety. Such anxiety is not merely negative anxiety; it can be understood as a form of academic vigilance that arises because of increased critical awareness.

This finding can also be related to the results of Ayanwale et al. (2024), which show the importance of AI literacy for prospective teachers. Prospective mathematics teachers are in a dual position: as statistics learners and as prospective educators who will use technology pedagogically. When students understand AI better, they can realize that using AI in mathematics and statistics learning is not enough if it only means copying answers. They must be able to explain reasons, assess accuracy, uphold academic ethics, and ensure alignment with learning objectives. These professional demands can add to anxiety, especially in students who are building an identity as prospective teachers.

Statistics self-efficacy has a significant negative effect on statistics anxiety, with $B = -0.333$, $\beta = -0.256$, $t = -2.199$, and $p = 0.030$. This result shows that, after AI literacy is controlled, students with higher self-efficacy tend to have lower statistics anxiety. In other words, self-efficacy acts as a protective factor in the regression model. This finding is in line with Kaufmann et al. (2022), who showed that self-efficacy is negatively related to statistics anxiety. When students believe they are able to understand concepts, complete tasks, and interpret output, psychological pressure in learning statistics can decrease. Self-belief makes students more willing to try, more resilient to mistakes, and better prepared to improve their understanding.

Interestingly, self-efficacy was not significant in the bivariate correlation with statistics anxiety but became significantly negative in the regression after AI literacy was included. This pattern suggests the possibility of a suppressor effect, or suppressor-like pattern. AI literacy and self-efficacy are strongly and positively correlated, while AI literacy itself is positively related to anxiety. When the influence of AI literacy is controlled, the component of self-efficacy that is purer as academic belief emerges as a factor that lowers anxiety. Thus, self-efficacy does not appear to be simply related in the bivariate correlation because its influence is mixed with the high level of AI literacy. However, in the multivariate model, self-efficacy shows a clearer protective role.

Theoretically, this pattern is logical. Students who are AI-literate and have high self-efficacy may still be aware of the risks of AI use, but they have the confidence to check, correct, and account for the results of their analysis. Conversely, students who are AI-literate but whose self-efficacy is not strong enough may experience higher anxiety because they know the complexity of the task without feeling fully capable of coping with it. In the learning context, this shows that increasing AI literacy must be accompanied by strengthening self-efficacy. AI-based learning that emphasizes only the use of tools can raise students' awareness but does not necessarily reduce anxiety if students are not given successful experiences, gradual practice, and support to understand statistical concepts.

This finding enriches the results of Mendes et al. (2025), who affirmed that psychological interventions in statistics need to be directed at reducing anxiety while increasing self-efficacy. In the context of AI, such interventions can be carried out through staged tasks, formative feedback, reflection on AI use, and practice in validating AI results. AI can be used to help students learn, but lecturers need to guide students so that AI is used as a thinking partner. Meegan & Young (2025) used the notion of AI as a tool, not a crutch. This principle is relevant to the findings because students need to understand that AI can help exploration, but conceptual understanding and the final decision remain with the students.

The results are also relevant to Dodeen et al. (2025), who showed that statistics anxiety, attitudes toward statistics, and self-efficacy are interrelated with students' academic achievement. Although this study did not measure academic achievement, statistics anxiety that remains in the moderate category indicates a potential learning barrier. Anxious students may avoid statistical tasks, delay analysis, rely too heavily on AI, or feel unsure about their work. If this condition is not managed, high AI literacy can instead turn into a burden, because students understand the complexity of the technology but lack adequate regulation strategies.

From the perspective of mathematics learning, this finding is in line with Gabriel et al. (2020), who emphasized that mathematics anxiety can affect self-regulation and mathematical literacy. In statistics learning, self-regulation is needed when students face data, choose analysis procedures, read output, and draw conclusions. AI can speed up access to information but does not automatically form self-regulation. Students still need to plan analysis steps, evaluate answers, and revise conclusions. Therefore, lecturers need to develop learning designs that combine statistics practice, reflection on AI use, and anxiety management strategies.

The dominant variable in the model is AI literacy because it has the highest standardized beta ($\beta = 0.435$). The dominance of AI literacy shows that, in the context of this study, statistics anxiety is explained more by how students understand and interpret the use of AI than by self-belief alone. This dominance does not mean that AI literacy is bad; rather, it shows that AI literacy must be pedagogically directed. Good AI literacy needs to be accompanied by the ability to ask appropriate questions, check statistical procedures, compare sources, understand the limitations of AI, and make concept-based decisions. Without guidance, students who become increasingly aware of AI may experience anxiety because they feel they must master two things at once: statistical concepts and ways of validating technology.

The regression results also show that Educational Statistics learning needs to move from a procedural orientation toward a reflective, AI-based statistical literacy orientation. It is not enough to give students tasks of calculating or running software; they need to be trained to explain why a test is used, how to read significance values, what a coefficient means, and how to check whether an AI answer is consistent with statistical principles. With such strategies, AI is positioned not as a single source of answers but as a tool for enriching discussion, speeding up feedback, and building conceptual understanding. This approach is in line with Maryati et al. (2026), who emphasized the contribution of generative AI in supporting the statistical literacy of prospective mathematics teachers.

The practical implication of this study is the need for a learning design that integrates AI literacy, self-efficacy, and anxiety regulation. First, lecturers can provide explicit guidance on how to use AI for learning statistics, for example by writing prompts that ask for explanations of concepts, check analysis steps, or compare interpretations of output. Second, lecturers need to emphasize the validation process so that students do not immediately accept AI answers. Third, self-efficacy can be built through staged tasks, worked examples, practice with feedback, and small

experiences of success. Fourth, anxiety can be reduced through learning that is safe for trying, discussion of common mistakes, and assessment that emphasizes the thinking process. Thus, AI-based learning not only increases technological literacy but also strengthens students' psychological readiness.

Conceptually, this study contributes to the development of Educational Statistics learning models in the AI era. The results show that AI literacy has two sides. On the one hand, AI literacy is strongly related to self-efficacy and can expand students' access to learning resources. On the other hand, AI literacy can also increase anxiety because students become more aware of the risks of error, ethics, and academic responsibility. Therefore, AI-based learning strategies need to balance technological empowerment with strengthening student agency. Prospective mathematics teachers need to be helped to see AI as a learning partner that must be critically controlled, not as an authority that replaces statistical understanding.

These findings also clarify the novelty of this study. Unlike research that places AI only as a technological innovation or self-efficacy only as a general psychological factor, this study shows that AI literacy and self-efficacy play different roles in explaining statistics anxiety. AI literacy is the dominant predictor with a positive direction, whereas self-efficacy is a negative predictor after being controlled. This pattern provides a basis for designing more specific learning interventions: increasing AI literacy must be accompanied by strengthening self-efficacy so that anxiety does not increase as a side effect of critical awareness that is not yet balanced by academic self-belief.

Although the model is significant, the relatively small R Square indicates that further research needs to include other variables. Variables that could be considered include experience using AI, frequency of use of statistical software, attitudes toward statistics, lecturer support, self-regulation strategies, mathematical literacy, previous experiences of failure, and learning goal orientation. Further research can also use mediation or moderation designs to test whether self-efficacy mediates or moderates the relationship between AI literacy and statistics anxiety. In addition, a mixed-methods approach can be used to explore why students who are AI-literate experience higher anxiety.

3.6 Summary of Findings and Hypothesis Discussion

A summary of the research findings is presented in Table 9.

Table 9. Summary of the Research Findings

No.	Finding	Interpretation and Discussion
1	AI literacy has a significant positive effect on statistics anxiety.	AI literacy increases critical awareness, validation demands, and ethical caution in using AI for statistical tasks.
2	Self-efficacy has a significant negative effect in the regression model.	Self-efficacy acts as a protective factor after the effect of AI literacy is controlled.
3	AI literacy is the dominant variable.	AI literacy has the largest standardized beta, so the critical-technological aspect is the most prominent in explaining anxiety.
4	The model explains 10.5% of the variation in anxiety.	Statistics anxiety is multidimensional and is still influenced by other factors outside the model.
5	AI literacy is strongly correlated with self-efficacy.	AI can increase the sense of capability when used as a directed and reflective learning aid.

Based on the summary of findings, the hypothesis that AI literacy and self-efficacy simultaneously affect statistics anxiety is accepted. The partial hypothesis for AI literacy is also

accepted, but the direction of its effect is positive. The partial hypothesis for self-efficacy is accepted in the regression model, with a negative direction. These results show that the statistics anxiety of prospective mathematics teachers in the AI era cannot be understood linearly. Increasing AI literacy can expand students' abilities but can also increase vigilance and anxiety if it is not balanced by strong self-efficacy. Therefore, Educational Statistics learning needs to combine critical AI literacy training with strategies for strengthening students' self-belief.

4. CONCLUSION

This study shows that AI literacy, statistics self-efficacy, and statistics anxiety are three interrelated aspects of Educational Statistics learning among prospective mathematics teachers. Descriptively, students' AI literacy and statistics self-efficacy were in the high category, whereas statistics anxiety was in the moderate category. This condition shows that students already have good technological capital and self-belief but still face psychological pressure when dealing with statistical material, the use of applications, data interpretation, and academic responsibility in using AI.

The multiple linear regression model was significant with an R Square of 0.105. AI literacy had a significant positive effect on statistics anxiety and was the dominant variable in the model. This finding shows that AI literacy does not always reduce anxiety; rather, it can increase critical awareness of the risks, accuracy, ethics, and responsibility of AI use in statistical analysis. Statistics self-efficacy had a significant negative effect after AI literacy was controlled, so it acts as a protective factor against anxiety. This pattern confirms that AI-based learning needs to be balanced with strengthening self-efficacy so that students are not only able to use AI but also confident in validating and accounting for its results.

The implication of this study is the need for Educational Statistics learning that integrates critical AI literacy, staged statistics practice, formative feedback, ethical reflection, and anxiety regulation strategies. Lecturers can design activities that guide students to use AI to understand concepts while still asking them to explain reasons, check procedures, and assess the correctness of output. Further research is recommended to include other variables such as attitudes toward statistics, self-regulation, experience using AI, lecturer support, and statistical literacy ability so that the model explaining anxiety becomes more comprehensive.

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AUTHOR CONTRIBUTIONS

YND designed the study, developed the research instruments, collected and analyzed the data, interpreted the results, and prepared the manuscript. DKS strengthened the theoretical review,

validated the research methodology, assisted with the analysis of the results, and provided input for refining the substance of the article. DS and AN evaluated the research results, provided a critical review of the manuscript, refined the discussion section, and carried out the final validation of the article before publication. All authors have thoroughly reviewed the manuscript, provided their approval, and agreed to the final version of the manuscript to be published.

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