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FROM LEARNING ASSISTANT TO LEARNING DEPENDENCY: HOW ARTIFICIAL INTELLIGENCE USAGE, CRITICAL THINKING DISPOSITION, AND ACADEMIC PERFORMANCE AMONG MATHEMATICS EDUCATION STUDENTS

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Abstract

The rapid adoption of artificial intelligence (AI) in higher education has transformed students' learning practices, particularly in completing academic assignments and projects. However, the extent to which AI use influences academic performance remains inconclusive. This study investigated the effects of overall AI usage, the percentage of AI use in course projects, and mathematical disposition on undergraduate students' Grade Point Average (GPA). A quantitative correlational design was employed involving 39 undergraduate students. Data were collected using a validated AI usage questionnaire, a mathematical disposition questionnaire, self-reported percentage of AI use in course projects, and students' GPA. Multiple linear regression analysis was conducted after verifying the assumptions of normality, multicollinearity, and independence of residuals. The regression model was statistically significant ($F = 6.247$, $p = .002$) and explained 34.9% of the variance in GPA ($R^2 = .349$). Among the predictors, only the percentage of AI use in course projects significantly predicted GPA ($\beta = -0.614$, $p < .001$), whereas overall AI usage ($p = .651$) and mathematical disposition ($p = .695$) were not significant predictors. These findings indicate that AI use itself is not associated with lower academic performance. Instead, students' reliance on AI in completing course projects appears to be associated with GPA. Excessive dependence on AI-generated outputs without critical evaluation, revision, verification using credible academic sources, and integration of students' own reasoning may reduce the quality of academic work. Therefore, AI should be utilized as a learning assistant that supports critical thinking, creativity, and problem-solving rather than replacing students' independent intellectual engagement. The findings highlight the importance of promoting AI literacy and responsible AI use in higher education.

Keywords: artificial intelligence, AI usage, academic performance, critical thinking disposition

Abstrak

Penggunaan kecerdasan buatan (Artificial Intelligence/AI) yang berkembang pesat di pendidikan tinggi telah mengubah praktik belajar mahasiswa, khususnya dalam menyelesaikan tugas dan proyek akademik. Namun, sejauh mana penggunaan AI memengaruhi prestasi akademik masih menjadi perdebatan. Penelitian ini bertujuan untuk menganalisis pengaruh penggunaan AI secara keseluruhan, persentase penggunaan AI dalam proyek mata kuliah, dan disposisi matematis terhadap Indeks Prestasi Kumulatif (IPK) mahasiswa program sarjana. Penelitian ini menggunakan desain kuantitatif dengan pendekatan korelasional yang melibatkan 39 mahasiswa program sarjana. Data dikumpulkan melalui kuesioner penggunaan AI yang telah divalidasi, kuesioner disposisi matematis, laporan mandiri mengenai persentase penggunaan AI dalam proyek mata kuliah, serta data IPK mahasiswa. Analisis dilakukan menggunakan regresi linear berganda setelah memenuhi asumsi normalitas, multikolinearitas, dan independensi residual. Hasil analisis menunjukkan bahwa model regresi signifikan secara statistik ($F = 6,247$; $p = 0,002$) dan mampu menjelaskan 34,9% variasi IPK ($R^2 = 0,349$). Di antara seluruh variabel prediktor, hanya persentase penggunaan AI dalam proyek mata kuliah yang berpengaruh signifikan terhadap IPK ($\beta = -0,614$; $p < 0,001$), sedangkan penggunaan AI secara keseluruhan ($p = 0,651$) dan disposisi matematis ($p = 0,695$) tidak menunjukkan pengaruh yang signifikan. Temuan ini menunjukkan bahwa penggunaan AI itu sendiri tidak berkaitan dengan penurunan prestasi akademik. Sebaliknya, tingkat ketergantungan mahasiswa terhadap AI dalam menyelesaikan proyek mata kuliah tampak berkaitan dengan IPK yang diperoleh. Ketergantungan yang berlebihan terhadap hasil yang dihasilkan AI tanpa melakukan evaluasi kritis, revisi, verifikasi menggunakan sumber akademik yang kredibel, serta tanpa mengintegrasikan penalaran

mahasiswa sendiri berpotensi menurunkan kualitas hasil akademik. Oleh karena itu, AI sebaiknya dimanfaatkan sebagai asisten pembelajaran yang mendukung kemampuan berpikir kritis, kreativitas, dan pemecahan masalah, bukan sebagai pengganti keterlibatan intelektual mahasiswa. Temuan penelitian ini menegaskan pentingnya penguatan literasi AI dan penerapan penggunaan AI yang bertanggung jawab.

Kata kunci**:** *kecerdasan buatan, penggunaan AI, prestasi akademik, disposisi rpikir kritis*

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INTRODUCTION

Artificial Intelligence (AI) regularly use in this era, particularly the generative AI technologies like ChatGPT, Gemini, Claude, and Microsoft Copilot, has substantially transformed higher education worldwide (Dai et al., 2023; Madanchian & Taherdoost, 2025). These AI-powered tools are increasingly integrated into students' daily academic activities, including searching for information, solving mathematical problems, generating programming code, summarizing scientific literature, writing essays, and completing course projects (Dai et al., 2023; George, 2023; Naznin et al., 2025; Rashid, 2026). By providing immediate feedback, personalized explanations, and interactive learning support, AI very potential to improve efficiency on learning and enhance students academic experiences (George, 2023; Naseer et al., 2026). Consequently, AI is no longer viewed merely as a technological innovation but has become an integral component of modern higher education (Dai et al., 2023; Madanchian & Taherdoost, 2025; Naseer et al., 2026; Wang et al., 2023).

Apart from those things educational benefit, the widespread adoption of AI has also generated growing concern among educators and researchers (Olasunkanmi, 2026). Rather than functioning solely as a learning assistant, AI is increasingly being used to produce substantial portions of students' academic work (George, 2023). Lecturers have reported that although many students submit assignments and project reports with sophisticated language and well-organized structures, some demonstrate limited conceptual understanding when asked to explain or defend their work during classroom discussions or oral examinations. Such observations have raised important questions regarding whether AI genuinely enhances learning or merely improves the quality of academic products without promoting meaningful knowledge construction.

Academic performance, commonly measuring by Grade Point Average (GPA),constantly become the most prominent indicators of students success in higher education (York et al., 2015). GPA reflects students' cumulative achievement across courses and is influenced by numerous cognitive, behavioral, and motivational factors (Alyahyan & Dü, 2020; Scherer et al., 2017; York et al., 2015). AI is increasingly being used in learning

environments, understanding how different patterns of AI usage relate to students' academic performance has become an important research priority for universities re aiming to incorporate AI responsibly into teaching and learning.

Previous studies have reported inconsistent findings regarding the relation of AI use with GPA (Azamatova et al., 2023; Çakir, 2019; Dong et al., 2025; Essel et al., 2022; Jose et al., 2024; Zhai et al., 2024). Several studies have suggested that AI positively contributes to learning by providing personalized feedback, facilitating self-directed learning, increasing learning efficiency, and improving students' understanding of complex concepts (Azamatova et al., 2023; Çakir, 2019; Dong et al., 2025; Essel et al., 2022). Conversely, the other research argued excessive reliance on AI may diminish students cognitive engagement, critical reasoning and independent learning, potentially resulting in superficial understanding and poorer academic achievement (Azamatova et al., 2023; Liu et al., 2026; Zhai et al., 2024). Those inconsistent findings suggest that the educational effects of AI depend not simply on whether students use AI, but on the manner and purpose of its use.

One possible explanation for these inconsistent findings is that most previous studies have conceptualized AI usage as a single construct, typically measured by usage frequency or general intensity. Such an approach assumes that all forms of AI use exert similar effects on learning outcomes. In reality, however, students utilize AI for diverse academic purposes. Some students use AI primarily to clarify concepts, generate ideas, receive feedback, or improve academic writing, thereby supporting their own learning processes. Others rely heavily on AI to complete large portions of assignments and course projects with minimal independent reasoning. These fundamentally different patterns of AI use are likely to produce different educational consequences. Therefore, distinguishing between overall AI usage and the percentage of AI use in completing course projects may provide more accurate insight into how AI influences student academic achievement.

Besides AI usage, another factor that may contribute to academic performance is Critical Thinking Disposition (Ali & Awan, 2021). Critical Thinking Disposition refers to an individual's consistent tendency to engage in reflective reasoning, evaluate evidence objectively, seek accurate information, remain open to alternative perspectives, and make rational judgments when solving problems (Aizikovitsh-udi & Cheng, 2015). Unlike critical thinking skills, which emphasize cognitive ability, critical thinking disposition reflects students' willingness to apply those abilities consistently in academic contexts (Aizikovitsh-udi & Cheng, 2015; Ali & Awan, 2021; Comer et al., 2019). Students possessing stronger

critical thinking dispositions are more likely to develop the ability to critically assess AI-generated outputs and substantiate their accuracy using authoritative academic sources, revise AI-generated outputs, and integrate their own reasoning into academic work (Zhang & Liu, 2025). Consequently, they may benefit from AI without becoming overly dependent on it, thereby maintaining high-quality learning processes and stronger academic performance.

Although research investigating AI in higher education has increased rapidly (Alyahyan & Dü, 2020; Çakir, 2019; Chen, 2024; Essel et al., 2022; Zhang & Liu, 2025), several important research gaps remain. First, relatively few studies have simultaneously examined overall AI usage, the percentage of AI use in course projects, and critical thinking disposition as predictors of students' academic performance. Most previous research just focused on either the perceptions of students about AI, AI acceptance, or general AI usage without distinguishing productive AI-assisted learning from excessive AI dependency. Second, empirical studies examining these relationships within mathematics teacher education programs remain limited, despite mathematics education requiring substantial analytical reasoning, conceptual understanding, and problem-solving skills that may be particularly influenced by AI-assisted learning. Third, little empirical evidence is available from developing countries, including Indonesia, where AI adoption has expanded rapidly while institutional policies governing responsible AI use continue to evolve. When AI is employed as a learning assistant to generate ideas, provide explanations, or offer formative feedback, it may stimulate students' reasoning and support deeper learning (Alyahyan & Dü, 2020; Dong et al., 2025). However, when AI is used primarily to obtain instant answers or generate complete assignments with minimal cognitive engagement, students may gradually become less willing to analyze information independently, verify evidence, or construct their own arguments (Liu et al., 2026; Zhai et al., 2024). As time passes, Sustained dependence on AI-generated outputs may hinder the development of students' intellectual autonomy and self-directed learning capabilities, reduce their perseverance when solving complex problems, and discourage reflective thinking (Zhai et al., 2024). Consequently, students may rely increasingly on technological assistance rather than developing the higher-order thinking processes required for sustained academic success (Comer et al., 2019; Zhu et al., 2026) .

Addressing these research gaps is important because universities require empirical evidence to develop educational policies that optimum the advantage of AI while decrease the very potential risks associated with excessive technological dependence. Understanding whether students' academic performance is associated with overall AI usage, AI dependency during

project completion, or their disposition toward critical thinking will enable educators to design more effective instructional strategies and AI literacy programs. In light of these considerations, this study investigates the effects of Overall AI Usage, Percentage of AI Use in Course Projects, and Critical Thinking Disposition on undergraduate students' Grade Point Average (GPA) using multiple linear regression analysis. Unlike previous studies that primarily measure AI usage as a single construct, this study distinguishes between general AI usage and AI dependency in completing academic projects. The findings are expected to contribute to the growing body of literature on artificial intelligence in higher education by identifying which dimensions of AI usage are associated with academic performance. Furthermore, the study provides practical implications for lecturers and higher education institutions in promoting responsible AI use that supports independent learning, critical thinking, academic integrity, and sustainable academic achievement.

METHODS

This study utilized a quantitative explanatory research design to assess the extent to which Artificial Intelligence (AI) usage influences the critical thinking disposition of undergraduate mathematics education students. The study also investigated whether AI usage differed according to students' gender, year of study, and cumulative grade point average (GPA). The research adopted a cross-sectional survey design (Allen, 2017) in which data were collected at a single point in time using standardized questionnaires. Participants were drawn from undergraduate students enrolled in the Mathematics Education Study Program, Faculty of Teacher Training and Education, Universitas Kristen Indonesia. To ensure adequate representation of students with different GPA levels, proportionate stratified random sampling was used.

Three valid and reliable questionnaires were employed. The AI Usage Questionnaire was developed to measure how far students utilize generative AI while preparing academic assignments, projects, reports, and scientific writing. The instrument consisted of five dimensions: 1) Frequency of AI use; 2) Purpose of AI use; 3) Intensity of AI use; 4) AI dependency; and 5) Responsible and ethical AI use. Critical thinking disposition was measured using an instrument adapted from California Critical Thinking Disposition Inventory (CCTDI) (Facione et al., 1995). The questionnaire consisted of seven dimensions: 1) Inquisitiveness; 2) Open-mindedness; 3) Systematicity; 4) Analyticity; 5) Critical thinking self-confidence; 6)

Truth-seeking; and 7) Cognitive maturity. The percentage of AI use measuring by questionnaire to determine the percentage of AI use on student task and project in courses.

Participants indicated their level of agreement with each statement on a five-point Likert scale, where higher scores reflected stronger agreement, ranging from Strongly Disagree (1) to Strongly Agree (5). Higher scores represented greater utilization of AI in academic learning and stronger critical thinking disposition. Data were collected online using Google Forms of the 2026/2027 academic year. Respondents participated on a voluntary basis, and informed consent was obtained before the administration of the questionnaire. To uphold ethical research standards, participant identities were anonymized, and all collected data were treated as strictly confidential were guaranteed. Data analysis was conducted using IBM SPSS Statistics. To provide an overview of the data, descriptive statistics comprising frequencies, percentages, means, and standard deviations were calculated to summarize students' AI usage and critical thinking disposition. Before conducting the inferential analysis, the assumptions required for multiple linear regression were examined by assessing normality, homogeneity of variance, multicollinearity, linearity, homoscedasticity, and the independence of residuals. After all statistical assumptions had been verified, multiple linear regression analysis was performed to determine whether the percentage of AI use in course projects and overall AI usage significantly predicted students' critical thinking disposition.

RESULT AND DISCUSSION

The sample consisted of 39 undergraduate students. The GPA of students ranged from 3.46 to 3.93, and the mean of 3.76 (M = 3.763, SD = 0.126). This relatively high average GPA indicates that the participants generally demonstrated good academic performance. Furthermore, the small standard deviation suggests limited variability in GPA, indicating that the academic achievement of the participants was relatively homogeneous.

The overall AI usage score ranged from 74 to 126, with an average score of 107.36 (SD = 11.20). Considering the possible range of scores, the mean suggests that the participants generally reported high level of AI use in academic activities. Nevertheless, the standard deviation indicates moderate variability, implying that students differed in how extensively they incorporated AI into their learning processes. The statistics descriptive of the four variables investigated in this esearch: students' Grade Point Average (GPA), overall AI usage

(Score_AI), Critical Thinking Disposition (Score_Disposition), and the percentage of AI use in course projects (PercentageAIUSE).

Table 1. *Descriptive Statistics*

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
GPA	39	3,46	3,93	3,7628	,12563	,016
Score_AI	39	74,00	126,00	107,3590	11,19795	125,394
Score_Disposition	39	95,00	140,00	112,4872	7,73193	59,783
PercentageAIUSE	39	40,00	90,00	66,2821	14,45128	208,839
Valid N (listwise)	39					

Students' Critical Thinking Disposition scores ranged from 95 to 140, and the mean is 112.49 (*SD* = 7.73). The finding here indicate that most participants possessed a relatively positive mathematical disposition, reflecting favorable attitudes toward mathematics, including confidence, persistence, curiosity, and willingness to engage in mathematical problem-solving. The relatively small standard deviation further suggests that Critical Thinking Disposition was fairly consistent across the sample.

Regarding the percentage of AI use in course projects, participants reported values ranging from 40% to 90%, with an average of 66.28% (*SD* = 14.45). This indicates that, on average, students estimated that approximately two-thirds of their project completion process involved AI assistance. The comparatively larger standard deviation and variance for this variable indicate substantial differences among students in the extent to which they relied on AI during project completion.

Among all study variables, Percentage of AI Use exhibited the greatest variability (Variance = 208.839), whereas GPA demonstrated the smallest variability (Variance = 0.016). This pattern suggests that although students' academic performance was relatively similar, their reliance on AI in completing academic projects varied considerably

Table 2. *Tests of Normality*

	Kolmo-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	,106	39	,200*	,970	39	,380

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The normality of the regression residuals was examined using the Kolmogorov–Smirnov and Shapiro–Wilk tests. The Kolmogorov–Smirnov test produced a significance value of 0.200, while the Shapiro–Wilk test yielded a significance value of 0.380. Since both p-values

exceeded the 0.05 significance level, the null hypothesis of normality was not rejected, indicating that the standardized residuals were approximately normally distributed. Therefore, the normality assumption required for multiple linear regression analysis was satisfied.

Table 3. *Test of Homogeneity*

	Levene Statistic	df1	df2	Sig.
GPA	,358	1	37	,553
PercentageAIUSE	,013	1	37	,910
Score_AI	,291	1	37	,593
Score_Disposition	2,306	1	37	,137

The Levene's test was used to test the homogeneity of variance. The results is non-significant values for GPA (p = 0.553), Percentage of AI Use (p = 0.910), Score_AI (p = 0.593), and Score_Disposition (p = 0.137). Because all p-values exceeded the 0.05 threshold, then the assumption of homogeneity was satisfied for all variables.

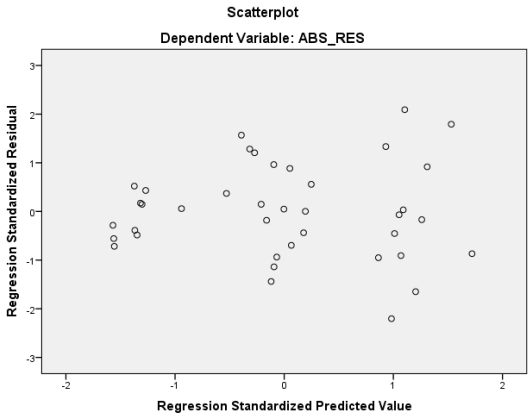

Figure 1. *Scatterplot of standardized residuals against standardized*

The Glejser procedure was employed to verify the homoscedasticity assumption by estimating a regression model in which the absolute values of the residuals were regressed on the predictor variables. The absence of statistically significant relationships indicated that the assumption of homoscedasticity was satisfied. From the result, Percentage of AI Use significantly explained the variation in the absolute residuals ($B = 0.037$, $t = 3.227$, $p = 0.003$), whereas Score_AI ($p = 0.560$) and Score_Disposition ($p = 0.639$) were not significant. These findings indicate evidence of heteroscedasticity associated with the Percentage of AI Use variable. A scatterplot of standardized residuals against standardized predicted values was examined to assess the homoscedasticity assumption. The residuals appeared to be randomly dispersed around the zero line without forming a distinct funnel, curved, or other systematic pattern. This visual inspection suggests that the variance of the residuals was reasonably

constant across the range of predicted values, indicating that the homoscedasticity assumption was broadly satisfied. Although the Glejser test indicated a significant association between Percentage of AI Use and the absolute residuals (p = 0.003), the residual scatterplot did not reveal a clear pattern of increasing or decreasing variance. This suggests that any heteroscedasticity present is likely to be mild rather than severe.

Table 4. *ANOVA*[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,209	3	,070	6,247	,002[b]
	Residual	,391	35	,011		
	Total	,600	38			

a. Dependent Variable: GPA

b. Predictors: (Constant), Score_Disposition, Percentange_UseAI, Score_AI

The ANOVA table above, statistically significant for the multiple regression model, with F (3, 35) = 6.247, p = 0.002, suggesting that the set of predictors jointly show significant proportion of the variance in students' GPA. The model shows for 34.9% of the variance in GPA (R^2 = 0.349), while the remaining 65.1% was attributable to factors not included in the model. Subsequent coefficient analysis revealed that this overall significance was primarily explained by the percentage of AI use in course projects, whereas the overall AI usage score and Critical Thinking Disposition did not contribute significantly after controlling for the other predictors.

Table 5. *Coefficients*[a]

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B		Collinearity Statistics	
Model	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	3,787	,287		13,184	,000	3,204	4,371		
Percentange_UseAI	-,100	,025	-,614	-4,066	,000	-,149	-,050	,816	1,226
Score_AI	,001	,002	,069	,456	,651	-,003	,004	,808	1,238
Score_Disposition	,001	,002	,054	,395	,695	-,004	,005	,989	1,011

a. Dependent Variable: GPA

Table 5 presents the regression coefficients for the multiple linear regression model predicting students' GPA. Among the three predictors, only the percentage of AI use in course projects significantly predicted GPA (B = -0.100, β = -0.614, t = -4.066, $p < 0.001$). The

negative coefficient indicates that students who reported a higher proportion of AI use in completing course projects tended to have lower GPAs, after controlling for overall AI usage and mathematical disposition. In contrast, neither the overall AI usage score (B = 0.001, β = 0.069, p = 0.651) nor Critical Thinking Disposition (B = 0.001, β = 0.054, p = 0.695) significantly predicted GPA. Furthermore, tolerance values ranged from 0.808 to 0.989 and VIF values ranged from 1.011 to 1.238, indicating that multicollinearity was not a concern in the regression model. The multiple linear regression analysis was conducted to investigate whether the percentage of AI use in course projects (PercentageAIUSE)**,** overall AI usage (Score_AI), and Critical Thinking Disposition(Score_Disposition) significantly predicted students' academic performance (GPA). The estimated regression equation is

$$Y = 0{,}001X_1 + 0{,}001X_2 - 0{,}1X_3 + 3{,}787$$

where

Y: GPA

X_1 : Score of AI Usage

X_2 : Score Critical Thinking Disposition

X_3 : Percentage of AI Use

The overall regression model was statistically significant, $F(3{,}35) = 6.247$, $p = .002$ indicating that the three predictor variables jointly explained a significant proportion of the variance in students' GPA. The model produced a correlation coefficient of $R = 0.591$, with $R^2 = 0.349$, indicating that 34.9% of the variance in GPA was explained by the combined effects of PercentageAIUSE, Score_AI, and Score_Disposition. The adjusted coefficient of determination was $Adjusted\ R^2 = 0.293$, suggesting that after adjusting for the number of predictors, approximately 29.3% of the variance in GPA remained explained by the model. Among the three predictors, only Percentage of AI Use significantly predicted GPA. The negative regression coefficient indicates that, holding the other predictors constant, students reporting a higher percentage of AI use in completing course projects tended to have lower GPAs. The 95% confidence interval ranged from -0.149 to -0.050, which did not include zero, further confirming the statistical significance of the relationship. In contrast, neither Score_AI nor Score_Disposition significantly predicted GPA. These findings indicate that neither students' overall AI usage behavior nor their Critical Thinking Disposition explained significant differences in academic achievement after accounting for the percentage of AI use in course projects. Furthermore, the multicollinearity statistics indicated that all tolerance

values exceeded 0.80 and all VIF values were close to 1.0, demonstrating that the predictor variables were sufficiently independent and that multicollinearity was not a concern.

The key finding of the present study is a higher percentage of AI use in completing course projects was associated with a lower GPA. Importantly, this finding should not be interpreted as evidence that AI itself reduces students' academic performance. Rather, the results suggest that the way students use AI during the completion of academic assignments is more important than AI usage itself. Interestingly, the overall AI usage score (Score_AI) was not a significant predictor of GPA. This indicates that simply using AI frequently or reporting positive AI usage behaviors does not necessarily influence academic achievement. Students may use AI for various educational purposes, including brainstorming ideas, obtaining explanations, checking grammar, improving programming code, or understanding difficult concepts. These forms of AI-assisted learning are generally intended to support the learning process rather than replace it.

In contrast, the significant negative association observed for Percentage of AI Use suggests that students who reported relying on AI for a larger proportion of their course projects tended to achieve lower GPAs. One possible explanation is that excessive dependence on AI-generated outputs may limit students intellectual engagement in the cognitive thinking processes required for meaningful learning. When students submit AI-generated content with minimal critical evaluation, revision, or integration of reliable academic references, they may miss opportunities to develop conceptual understanding, analytical reasoning, and disciplinary knowledge that are essential for producing high-quality academic work.

Therefore, the findings of this study do not imply that AI lowers students' GPA. Instead, they suggest that overreliance on AI without active intellectual engagement may be associated with lower academic performance. Students who simply copy and paste AI-generated responses into assignments or projects without verifying the information, correcting inaccuracies, enriching the content with credible references, or incorporating their own ideas are less likely to produce work that demonstrates deep understanding and originality. Consequently, such assignments may receive lower evaluation scores, which ultimately contribute to a lower GPA.

This interpretation is consistent with the educational principle that learning occurs most effectively when students actively construct knowledge rather than passively receive information. Artificial intelligence is capable of generating coherent text and providing rapid solutions; however, it cannot replace students' responsibility to evaluate evidence, synthesize

information, and apply critical thinking within their own academic context. The quality of learning therefore cannot be explained solely by the availability of AI tools as well as on how students interact with these technologies during the learning process.

Another important finding is that Critical Thinking Disposition did not significantly predict GPA after controlling for AI-related variables. Although previous research has frequently reported positive relationships between Critical Thinking Disposition and academic achievement, the present study did not observe such an effect. A plausible explanation is that the participants generally exhibited relatively high Critical Thinking Disposition scores with limited variability, reducing the ability of this variable to explain differences in GPA. Furthermore, GPA reflects overall academic performance across multiple subjects rather than mathematical achievement alone, suggesting that other academic and behavioral factors may have a greater influence on cumulative academic performance.

The results also provide contribute significant effect for the Implementing AI in higher education. The findings suggest that educational institutions should encourage responsible and pedagogically meaningful AI use rather than discourage AI altogether (Dai et al., 2023; George, 2023). AI should be positioned as a learning assistant that helps students explore ideas, obtain feedback, improve writing quality, and understand complex concepts. However, it should not become a substitute for students' independent thinking, creativity, problem-solving processes, or academic judgment.

Educational practices should encourage students to critically examine AI-generated responses rather than accepting them without question, verify information using authoritative academic sources, compare multiple references, and revise AI-generated content according to disciplinary standards before submitting assignments. Such practices enable students to benefit from AI while simultaneously strengthening higher-order thinking skills, academic integrity, and subject mastery (Ali & Awan, 2021; Zhang & Liu, 2025). Consequently, The function of AI only a cognitive support tool not a replacement for students' intellectual process learning.

From a practical perspective, the present result shows about quality of how AI use is more important than the quantity of AI use. Students who use AI wisely—as a tool for learning support, idea generation, and revision—are more likely to produce higher-quality projects than students who depend heavily on AI-generated content without meaningful modification. Therefore, educational policies should focus on developing students' AI literacy, including rethinking the result from AI, how ethical use, information verification, and responsible academic writing. Finally, although the regression model explained approximately 34.9% of

the variance in GPA, approximately 65.1% of the variation remained unexplained. This finding indicates that academic performance is influenced by numerous factors beyond AI usage and mathematical disposition, such as prior academic ability, self-regulated learning, motivation, study habits, time management, learning strategies, assessment design, and socioeconomic conditions (Doe et al., 2025; Zollanvari et al., 2017). University regulators must establish boundaries for AI use and how it can be used. While AI is a tool, ideas, innovation, critical thinking, and scientific thinking must be championed and accounted for. The next research should add these variables then develop a greater insight into how AI interacts with students' learning behaviors and academic achievement.

Evidence from this study suggests that AI itself is not detrimental to students' academic performance. Rather, the educational outcomes associated with AI depend on how students use it. Responsible, reflective, and critical use of AI can support learning and improve the quality of academic work, whereas excessive reliance on AI as an alternative for students own thinking may limit learning opportunities and be associated with lower academic achievement. Consequently, the challenge for higher education is not to reduce students' access to AI, but to cultivate the competencies needed to use AI ethically, critically, and creatively as a tools in learning instead of serving as a substitute for human cognition.

CONCLUSION

This study investigated the relationship between overall AI usage, the percentage of AI use in course projects, mathematical disposition, and students' academic performance (GPA) among undergraduate students. The findings revealed that the multiple regression model was statistically significant, explaining 34.9% of the variance in GPA. Among the three predictor variables, only the percentage of AI use in course projects significantly predicted students' GPA, whereas overall AI usage and Critical Thinking Disposition were not significant predictors. The results indicate that AI itself is not associated with lower academic performance. Instead, the findings suggest that students' reliance on AI during the completion of course projects is associated with academic achievement. Specifically, students who reported using AI for a larger proportion of their project work tended to have lower GPAs. This relationship should be interpreted as an association rather than evidence of causation. A plausible explanation is that students who depend heavily on AI-generated outputs without critically reviewing, revising, validating information through reliable academic sources, or incorporating their own reasoning and creativity may produce lower-quality academic work.

These findings highlight the educational potential of artificial intelligence rely not on whether students use AI, but on how they use it. AI should be viewed as an intelligent learning assistant that supports idea generation, information retrieval, feedback, and revision rather than as a substitute for students' independent thinking, creativity, and problem-solving abilities. Responsible and critical AI use allows students to enhance the quality of their learning and academic projects while maintaining academic integrity and developing higher-order thinking skills. The principal finding extent to which students rely on AI in completing course projects is a stronger predictor of academic performance than AI usage itself. Because the present model explained approximately one-third of the variance in GPA, the next study might be investigated additional factors like self-regulated learning, learning motivation, critical thinking, academic integrity, digital literacy, and learning strategies to complete the deeper understanding of how AI influences student academic performance.

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