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Innovativeness and Adoption of Generative Artificial Intelligence in Learning: Evidence from Islamic Primary Teacher Education Students

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Abstract

The integration of digital technology, particularly Generative Artificial Intelligence (AI), has become a crucial demand in contemporary teacher education. However, the extent to which student innovativeness influences AI adoption in learning remains underexplored, especially among Islamic Primary Teacher Education (PGMI) students. This study aims to examine the level of student innovativeness and its effect on the adoption of Generative AI in learning. This research employed a quantitative survey design involving 120 undergraduate PGMI students selected through purposive sampling, specifically those who had prior experience using Generative AI tools. Data were collected using a validated questionnaire consisting of 18 items, covering student innovativeness (8 items) and AI adoption (10 items), measured on a 5-point Likert scale. The instrument demonstrated strong validity (r-count > r-table = 0.179) and high reliability (Cronbach's Alpha: 0.89 for innovativeness and 0.93 for AI adoption). Data were analyzed using descriptive statistics, Pearson correlation, and simple linear regression. The results show that student innovativeness (M = 3.82; SD = 0.56) and AI adoption (M = 3.75; SD = 0.61) are both categorized as high. A significant positive correlation was found between innovativeness and AI adoption ($r = 0.621$, $p < 0.001$). Furthermore, regression analysis indicates that student innovativeness significantly predicts AI adoption ($\beta = 0.655$, $t = 9.876$, $p < 0.001$), explaining 38.6% of the variance ($R^2 = 0.386$). These findings suggest that more innovative students are more likely to adopt and utilize Generative AI effectively in learning activities. Despite these positive findings, challenges such as limited digital literacy, ethical concerns, and lack of pedagogical guidance remain evident. This study highlights the importance of fostering student innovativeness alongside structured institutional support, including digital literacy training and ethical frameworks, to optimize the integration of Generative AI in teacher education.

Keywords: Generative Artificial Intelligence; Student Innovativeness; Technology Adoption; Diffusion of Innovation.

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Abstrak

Integrasi teknologi digital, khususnya Generative Artificial Intelligence (AI), menjadi tuntutan penting dalam pendidikan guru di era modern. Namun, sejauh mana keinovatifan mahasiswa memengaruhi adopsi AI dalam pembelajaran masih belum banyak dikaji, terutama pada mahasiswa Pendidikan Guru Madrasah Ibtidaiyah (PGMI). Penelitian ini bertujuan untuk menganalisis tingkat keinovatifan mahasiswa serta pengaruhnya terhadap adopsi Generative AI dalam pembelajaran. Penelitian ini menggunakan pendekatan kuantitatif dengan desain survei yang melibatkan 120 mahasiswa PGMI yang dipilih melalui teknik purposive sampling, yaitu mahasiswa yang telah menggunakan teknologi Generative AI dalam kegiatan belajar. Data dikumpulkan menggunakan kuesioner tervalidasi yang terdiri dari 18 butir pernyataan, meliputi keinovatifan mahasiswa (8 item) dan adopsi AI (10 item), dengan skala Likert 5 poin. Instrumen penelitian menunjukkan validitas yang baik (r-hitung > r-tabel = 0,179) dan reliabilitas tinggi (Cronbach's Alpha: 0,89 untuk keinovatifan dan 0,93 untuk adopsi AI). Analisis data dilakukan menggunakan statistik deskriptif, korelasi Pearson, dan regresi linier sederhana. Hasil penelitian menunjukkan bahwa keinovatifan mahasiswa (M = 3,82; SD = 0,56) dan adopsi Generative AI (M = 3,75; SD = 0,61) berada pada kategori tinggi. Terdapat hubungan positif dan signifikan antara keinovatifan dan adopsi AI (r = 0,621; p < 0,001). Selain itu, hasil analisis regresi menunjukkan bahwa keinovatifan mahasiswa berpengaruh signifikan terhadap adopsi AI (β = 0,655; t = 9,876; p < 0,001) dengan kontribusi sebesar 38,6% (R^2 = 0,386). Temuan ini menunjukkan bahwa mahasiswa yang lebih inovatif cenderung lebih aktif dalam mengadopsi dan memanfaatkan Generative AI dalam pembelajaran. Meskipun demikian, masih terdapat kesenjangan antara tingkat keinovatifan dan pemanfaatan AI secara optimal, terutama dalam pengembangan inovasi pembelajaran. Selain itu, isu literasi digital, integritas akademik, dan pemanfaatan AI secara etis masih menjadi tantangan. Oleh karena itu, diperlukan dukungan institusional melalui penguatan literasi digital, pengembangan kerangka pedagogis, serta pedoman etika dalam penggunaan AI untuk mengoptimalkan integrasinya dalam pendidikan guru.

Kata kunci: *Generative Artificial Intelligence, Keinovatifan Mahasiswa, Adopsi Teknologi, Difusi Inovasi.*

INTRODUCTION

The rapid advancement of digital technology in the era of Society 5.0 has significantly transformed various aspects of human life, including education. One of the most disruptive innovations in recent years is Generative Artificial Intelligence (AI), which is capable of producing text, images, and various forms of instructional content autonomously. In higher education, including teacher education programs, Generative AI has begun to reshape how students access information, construct knowledge, and engage in learning processes (Holmes

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et al., 2022; Kasneci et al., 2023). This transformation signals a shift from conventional learning toward more adaptive, personalized, and technology-driven environments.

In this context, teachers are no longer merely transmitters of knowledge but are expected to become digitally literate professionals who can effectively integrate technology into pedagogical practices. Digital literacy, including the ability to critically and ethically use AI technologies, has become a fundamental competency for prospective teachers in the 21st century. Global trends and policy directions emphasize that future educators must not only be technology users but also innovators who can design meaningful learning experiences supported by emerging technologies, including AI.

However, despite the growing availability of Generative AI tools, their adoption in learning does not occur uniformly among students. The integration of such technologies is influenced by various factors, including individual characteristics, technological readiness, and pedagogical awareness (Venkatesh et al., 2003; Teo, 2011). One critical factor that determines the success of innovation adoption is individual innovativeness. According to Diffusion of Innovation theory, innovativeness refers to the degree to which an individual is relatively earlier in adopting new ideas compared to others (Rogers, 2003). Individuals with higher innovativeness tend to be more open to change, willing to experiment, and capable of exploring the potential of emerging technologies more effectively.

Previous studies have shown that personal innovativeness significantly influences the acceptance and use of technology in educational contexts (Agarwal & Prasad, 1998; Yi et al., 2006). Additionally, factors such as perceived usefulness, ease of use, and digital literacy have been identified as key determinants of technology adoption (Davis, 1989; Scherer et al., 2019). While these studies provide valuable insights, most of them focus on general technology adoption or specific tools, with limited attention to the role of innovativeness in the adoption of Generative AI, particularly in teacher education contexts.

Empirically, preliminary observations among PGMI students indicate that the use of Generative AI is already widespread; however, its utilization tends to be limited to basic academic tasks such as completing assignments, generating summaries, or searching for quick answers. Only a small proportion of students appear to use AI tools for more advanced purposes, such as designing learning materials, developing instructional media, or creating innovative teaching strategies. This phenomenon suggests a gap between the availability of AI technology and its optimal pedagogical utilization.

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From a policy perspective, the Indonesian government has also emphasized the importance of digital transformation in education through initiatives promoting digital learning and technological integration in classrooms. At the global level, reports from international organizations highlight that future teachers are expected to possess not only digital literacy but also AI literacy, which includes ethical awareness, critical thinking, and the ability to integrate AI into meaningful learning processes. These developments reinforce the urgency of examining how prospective teachers respond to AI technologies.

Despite the increasing attention to AI in education, studies specifically examining the relationship between student innovativeness and the adoption of Generative AI in Islamic Primary Teacher Education (PGMI) programs remain limited. This is particularly important because PGMI students, as future primary school teachers with an Islamic educational background, play a strategic role in integrating technology with pedagogical and ethical values in future classrooms.

Based on these considerations, this study offers a novel contribution by specifically examining the role of student innovativeness in predicting the adoption of Generative AI within the context of Islamic teacher education. Unlike previous studies that focus primarily on general technology acceptance, this research highlights the intersection between innovativeness, AI utilization, and pedagogical readiness among prospective teachers.

Accordingly, this study aims to: (1) identify the level of student innovativeness, (2) analyze the level of Generative AI adoption in learning, and (3) examine the influence of student innovativeness on the adoption of Generative AI among PGMI students. The findings of this study are expected to contribute to the development of innovation diffusion theory in education and provide practical implications for designing technology-integrated learning in teacher education programs.

RESEARCH METHODS

This study employed a quantitative approach using a survey design to examine the relationship between student innovativeness and the adoption of Generative Artificial Intelligence (AI) in learning. The design was chosen to enable statistical analysis of relationships among variables and to allow generalization within the target population.

The population of this study consisted of undergraduate students enrolled in the Islamic Primary Teacher Education (PGMI) program at UIN Syarif Hidayatullah Jakarta. The sample was selected using a purposive sampling technique, targeting students who had

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prior experience using Generative AI tools (such as ChatGPT or similar platforms) in their learning activities.

The total sample consisted of 120 students (N = 120), representing various academic cohorts (from second to eighth semester). This distribution was intended to ensure that the sample adequately represented the characteristics of the population in terms of academic experience and exposure to digital learning technologies.

To ensure that respondents met the study criteria, a screening question was included at the beginning of the questionnaire, asking whether participants had ever used Generative AI tools in their learning activities. Only respondents who answered "yes" were allowed to proceed with the survey. This step was conducted to verify the relevance and validity of the responses.

Data were collected using a structured questionnaire consisting of two main constructs: 1. Student Innovativeness, measured based on the Diffusion of Innovation theory (Rogers, 2003) and adapted from Agarwal and Prasad (1998). 2. Adoption of Generative AI in Learning, adapted from the Technology Acceptance Model (Davis, 1989).

The instrument consisted of a total of 18 items, including 8 items for Student Innovativeness and 10 items for Generative AI Adoption. All items were measured using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). To facilitate interpretation, the score categories were defined as follows: 1.00–1.80 = Very Low, 1.81–2.60 = Low, 2.61–3.40 = Moderate, 3.41–4.20 = High, and 4.21–5.00 = Very High.

To ensure the quality of the instrument, several validation procedures were conducted: 1) Content validity was evaluated through expert judgment in educational technology and instructional design. 2) Construct validity was tested using Pearson product-moment correlation, with all items showing r-count > r-table (0.179), indicating that all items were statistically valid. 3) Reliability was assessed using Cronbach's Alpha, with a coefficient of $\geq$ 0.70 considered acceptable. The results indicate high reliability, with coefficients of 0.89 for Student Innovativeness and 0.93 for Generative AI Adoption.

Data were collected through an online survey distributed to PGMI students. Participants were informed about the purpose of the study and provided consent before completing the questionnaire. To ensure objectivity and privacy, all responses were collected anonymously, and no personally identifiable information was recorded.

Data analysis was conducted using SPSS software through the following steps: 1) Descriptive Statistics: To describe the level of student innovativeness and AI adoption.

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2) Normality Test (Kolmogorov–Smirnov): To determine whether the data met the assumptions for parametric analysis. 3) Correlation Analysis (Pearson): To examine the relationship between innovativeness and AI adoption. 4). Simple Linear Regression Analysis: To test the effect of student innovativeness (independent variable) on the adoption of Generative AI (dependent variable). Inferential statistical analysis in this study specifically refers to Pearson correlation and simple linear regression, which were used to test the research hypothesis regarding the relationship and predictive influence between variables.

RESULTS AND DISCUSSION

RESULTS

1. Descriptive Statistics of Student Innovativeness and Generative AI Adoption

Table 1. Student Innovativeness and Generative AI Adoption

Variable	N	Mean	Std. Deviation	Category
Student Innovativeness	120	3.82	0.56	High
Generative AI Adoption	120	3.75	0.61	High

The results indicate that the mean score of student innovativeness is 3.82 (SD = 0.56), while the mean score of Generative AI adoption is 3.75 (SD = 0.61). Based on the predetermined classification (3.41–4.20 = High), both variables fall into the “High” category. This suggests that students generally demonstrate a strong tendency toward innovation and actively engage in the use of Generative AI in learning activities.

To enhance clarity, the distribution of mean scores is also illustrated in Figure 1, which shows that student innovativeness is slightly higher than AI adoption, indicating that although students are innovative, the utilization of AI has not yet reached its maximum potential.

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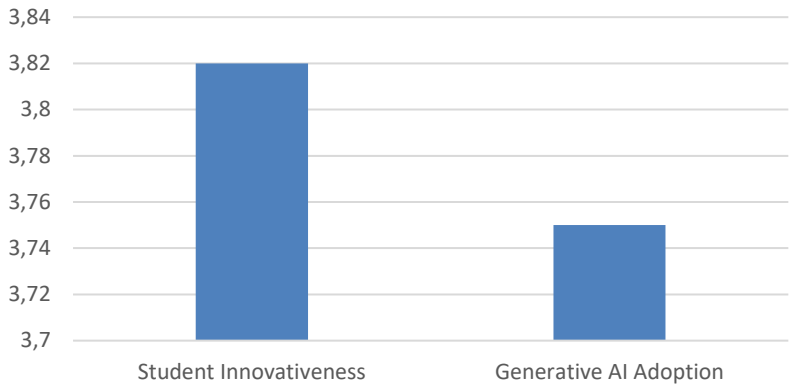

Figure 1. The distribution of mean scores

Figure 1 illustrates that the mean score of student innovativeness (M = 3.82) is slightly higher than that of Generative AI adoption (M = 3.75). Although the difference is relatively small, it indicates a gap between students' readiness to adopt innovation and their actual utilization of AI in learning. This suggests that while students demonstrate a strong innovative orientation, the practical use of AI has not yet been fully optimized, particularly for developing instructional innovations.

2. Distribution of Student Innovativeness Categories

This distribution is further visualized in Figure 2, providing a clearer overview of the proportion of each adopter category.

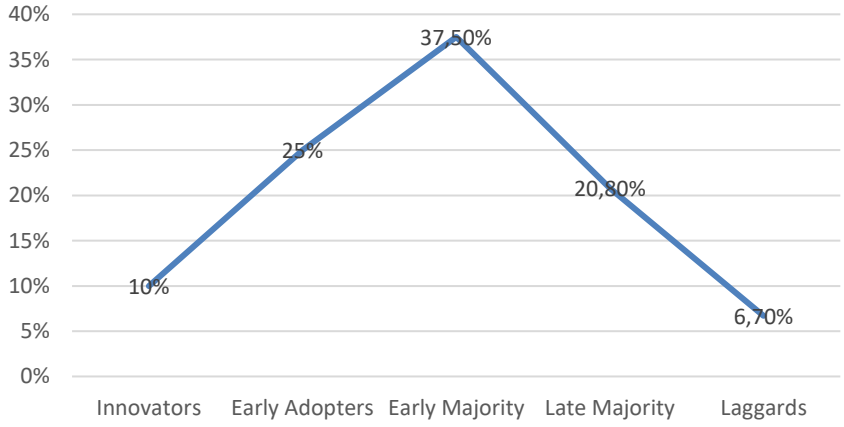

Figure 2. Distribution of Student Innovativeness Categories

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The figure shows that the largest proportion of respondents falls into the Early Majority category (37.5%), indicating that most students tend to adopt innovations after seeing evidence of their effectiveness. This is followed by Early Adopters (25%), who play a significant role as opinion leaders in influencing others. The Late Majority accounts for 20.8%, reflecting a considerable group that adopts innovations more cautiously and often due to external pressure or necessity. Meanwhile, Innovators represent only 10%, suggesting a relatively small group of risk-takers who are willing to experiment with new technologies at an early stage. The smallest proportion is found in the Laggards category (6.7%), indicating that only a few students are highly resistant to change. Overall, the distribution forms a typical diffusion curve, with a strong concentration in the middle categories, highlighting that most students are moderately receptive to adopting innovations rather than being extreme early or late adopters.

3. Normality Test

Table 3. Normality Test

Variable	Sig. (Kolmogorov-Smirnov)	Remark
Innovativeness	0.072	Normal
Generative AI Adoption	0.065	Normal

The significance values for both variables are greater than 0.05 ($p > 0.05$), indicating that the data are normally distributed. Therefore, parametric statistical analyses, including Pearson correlation and linear regression, are appropriate for further analysis.

4. Pearson Correlation Analysis

Table 4. Pearson Correlation Analysis

Variables	r	Sig. (p-value)	Interpretation
Innovativeness – AI Adoption	0.621	0.000	Significant (strong)

The Pearson correlation analysis reveals a strong positive relationship between student innovativeness and Generative AI adoption ($r = 0.621$, $p < 0.001$). This indicates that higher levels of innovativeness are associated with increased adoption of AI in learning. The significance value ($p < 0.001$) confirms that the relationship is statistically significant.

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5. Simple Linear Regression Analysis

Table 5. Regression Analysis

Variable	B	t	Sig.
(Constant)	1.245	4.321	0.000
Innovativeness	0.655	9.876	0.000

Model Summary	Value
R	0.621
R Square	0.386
Adjusted R Square	0.381

The regression analysis shows that student innovativeness has a significant effect on Generative AI adoption ($\beta = 0.655$, $t = 9.876$, $p < 0.001$). The coefficient of determination ($R^2 = 0.386$) indicates that 38.6% of the variance in AI adoption can be explained by student innovativeness, while the remaining 61.4% is influenced by other variables not examined in this study.

Overall, the results demonstrate that PGMI students exhibit a high level of innovativeness and a correspondingly high level of Generative AI adoption. The dominance of the early majority category suggests that students tend to adopt technology after recognizing its practical benefits. Importantly, the statistical analysis confirms that innovativeness is a significant predictor of AI adoption, both in terms of correlation ($r = 0.621$, $p < 0.001$) and regression ($\beta = 0.655$, $p < 0.001$).

However, the gap between innovativeness ($M = 3.82$) and AI adoption ($M = 3.75$) indicates that although students are relatively innovative, the use of AI has not yet been fully optimized, particularly in terms of developing instructional innovations rather than merely completing academic tasks.

DISCUSSION

The findings of this study reveal that PGMI students demonstrate a high level of innovativeness ($M = 3.82$) and a relatively high level of Generative Artificial Intelligence (AI) adoption ($M = 3.75$). These results indicate that students are generally open to new technologies and have begun to integrate AI into their learning activities. The slight difference between innovativeness and AI adoption scores suggests that although students possess a strong innovative orientation, the actual utilization of AI has not yet reached its optimal level.

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From the perspective of Diffusion of Innovation theory, individuals with higher levels of innovativeness tend to adopt new technologies earlier and more effectively (Rogers, 2003). This is empirically supported by the results of this study, which show a strong and significant relationship between innovativeness and AI adoption ($r = 0.621$, $p < 0.001$). This finding confirms that innovativeness plays a crucial role in determining how students respond to emerging technologies such as Generative AI. Students who are more innovative tend to be more curious, willing to experiment, and confident in using new tools, which ultimately facilitates their adoption behavior, It can also increase students' learning motivation, as shown by the findings of Huda et al. (Hakim, Suhartiningsih, & Sunaryati, 2025), which state that the use of digital technology in mathematics learning can enhance students' motivation to learn.

The regression analysis further strengthens this argument, indicating that student innovativeness significantly predicts AI adoption ($\beta = 0.655$, $p < 0.001$), explaining 38.6% of the variance ($R^2 = 0.386$). This implies that while innovativeness is a strong predictor, more than half of the variance (61.4%) is influenced by other factors, suggesting that technology adoption is a multidimensional process. This result aligns with the Technology Acceptance Model (TAM), which emphasizes that perceived usefulness, perceived ease of use, and external variables also contribute to technology adoption (Davis, 1989; Venkatesh et al., 2003).

The distribution of students across innovation categories further enriches the interpretation. The majority of students fall into the early majority category (37.5%), followed by early adopters (25%). This pattern indicates that most students tend to adopt technology after observing its benefits rather than initiating its use independently. While this creates a stable environment for diffusion, it also suggests that innovation growth may depend on a smaller group of innovators (10%) who can act as change agents within the learning community.

Empirically, this finding is consistent with initial observations showing that many students use Generative AI primarily for completing assignments, summarizing materials, or searching for quick answers, rather than for developing instructional innovations such as designing teaching media or creating interactive learning content. This highlights a gap between the availability of AI technology and its pedagogical utilization, reinforcing the need for structured guidance in its use.

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In the context of Islamic Primary Teacher Education (PGMI), these findings carry significant implications. As prospective teachers, students are expected not only to master technology but also to integrate it with pedagogical competence and ethical values. The integration of Generative AI in education must be aligned with the principles of academic integrity and Islamic ethical values, ensuring that AI is used as a tool for intellectual empowerment rather than as a shortcut leading to plagiarism or academic dishonesty.

Concerns related to academic integrity become particularly relevant, as the ease of accessing AI-generated content may encourage superficial learning if not properly guided. Therefore, it is essential to develop clear ethical guidelines and instructional strategies that promote responsible AI use, such as emphasizing originality, critical thinking, and reflective learning. This aligns with global concerns regarding the ethical use of AI in education (Zawacki-Richter et al., 2019; UNESCO, 2021).

Furthermore, the gap between innovativeness and actual AI adoption suggests that institutional support plays a crucial role. Students may be willing to adopt AI, but without adequate digital literacy training, pedagogical frameworks, and lecturer guidance, their use of AI may remain limited and suboptimal. This finding supports previous studies indicating that technological readiness alone is insufficient without structured support systems (Dwivedi et al., 2023).

Thus, innovativeness can be seen as a necessary but not sufficient condition for effective AI adoption. It acts as a catalyst, but its impact must be supported by enabling environments, including curriculum integration, digital literacy programs, and ethical guidelines.

Overall, this study contributes to the growing body of knowledge by demonstrating that student innovativeness significantly influences the adoption of Generative AI in learning, particularly within the context of Islamic teacher education. Unlike previous studies that focus primarily on general technology acceptance, this study highlights the importance of aligning technological innovation with pedagogical readiness and ethical responsibility.

CONCLUSION

This study aimed to examine the role of student innovativeness in the adoption of Generative Artificial Intelligence (AI) in learning among Islamic Primary Teacher Education (PGMI) students. The findings indicate that students demonstrate a relatively high level of innovativeness and a high level of AI adoption in learning activities. Statistically, the results

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show that student innovativeness has a mean score of 3.82 (SD = 0.56), while Generative AI adoption has a mean score of 3.75 (SD = 0.61), both categorized as high. Furthermore, there is a strong and significant positive relationship between innovativeness and AI adoption ($r = 0.621$, $p < 0.001$). Regression analysis also confirms that innovativeness significantly predicts AI adoption ($\beta = 0.655$, $p < 0.001$), explaining 38.6% of the variance ($R^2 = 0.386$). These findings confirm that student innovativeness plays a crucial role in facilitating the integration of Generative AI in learning. However, the slight gap between innovativeness and AI adoption indicates that although students are ready to embrace innovation, the actual utilization of AI has not yet been fully optimized, particularly in developing instructional innovations rather than merely completing academic tasks. This suggests that innovativeness alone is not sufficient, and additional supporting factors are required to enhance effective AI integration. This study also highlights that the adoption of Generative AI must be accompanied by strong academic integrity and ethical awareness, especially within the context of Islamic education. The use of AI should promote critical thinking and intellectual development rather than lead to dependency or academic dishonesty. Despite its contributions, this study has several limitations. First, the sample was limited to 120 PGMI students from a single institution, which may restrict the generalizability of the findings. Second, the study focused only on student innovativeness as the main predictor, while other relevant factors such as digital literacy, perceived usefulness, institutional support, and ethical awareness were not examined in depth. Third, the use of self-reported data may introduce response bias.

Therefore, future research is recommended to involve a larger and more diverse sample across multiple institutions, incorporate additional variables to provide a more comprehensive model of AI adoption, and employ mixed-method approaches to gain deeper insights into students' actual practices in using Generative AI. In conclusion, this study contributes to the development of educational technology research by reinforcing the relevance of Diffusion of Innovation theory and the Technology Acceptance Model in explaining the adoption of Generative AI in teacher education. More importantly, this study emphasizes that successful AI integration requires not only innovative individuals but also supportive ecosystems, including digital literacy development, pedagogical guidance, and ethical frameworks.

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