



Original Article

## Determinants of Artificial Intelligence Utilization and Its Impact on Learning Quality among Generation Z Students

Jundi Syaddad <sup>a</sup> and Tutus Rully <sup>a,\*</sup>

<sup>a</sup> Department of Management, Faculty of Economics and Business, Pakuan University, 16129 Kota Bogor, Jawa Barat, Indonesia. (J.S.)

\* Correspondence: [tutus.rully@unpak.ac.id](mailto:tutus.rully@unpak.ac.id) (T.R.)

**Citations:** Syaddad, J., & Rully, T. (2025). Determinants of Artificial Intelligence Utilization and Its Impact on Learning Quality among Generation Z Students. *Journal of Madani Society*, 4(2), 75-83.

Received: 16 May 2025

Revised: 8 July 2025

Accepted: 5 August 2025

Published: 31 August 2025

**Abstract:** The rapid integration of Artificial Intelligence (AI) in higher education has created new opportunities to enhance learning quality, particularly among Generation Z students who are highly engaged with digital technologies. However, the effectiveness of AI depends on students' digital competence and its practical application in learning environments. This study aims to examine the relationships among digital competence, AI utilization, and learning quality, and the mediating role of AI utilization among Generation Z students at private universities in Bogor City. A quantitative explanatory research design was employed, with data collected from 220 respondents using purposive sampling. Structural Equation Modeling (SEM) with LISREL 8.8 was used to analyze the data. The results indicate that digital competence has a positive and significant effect on AI utilization, but its direct effect on learning quality is not significant. In contrast, AI use has a positive, significant effect on learning quality. Furthermore, AI utilization is found to significantly mediate the relationship between digital competence and learning quality, indicating that digital skills contribute to learning outcomes primarily through their application in AI-supported learning. These findings suggest that the effectiveness of digital competence depends on how it is operationalized through AI technologies. Therefore, higher education institutions should not only enhance students' digital competence but also promote the effective integration of AI into teaching and learning processes to improve overall learning quality.

**Keywords:** Artificial Intelligence Utilization; Digital Competence; Learning Quality; Generation Z; Higher Education



Copyright: © 2025 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

### 1. Introduction

The rapid advancement of Artificial Intelligence (AI) has fundamentally transformed higher education by enabling more personalized, efficient, and data-driven learning environments. AI technologies, including intelligent tutoring systems, adaptive learning platforms, learning analytics, and generative AI, are increasingly adopted to enhance instructional quality, student engagement, and academic performance (Ryzheva et al., 2024; Iman et al., 2024; Hardini et al., 2025). These technologies support personalized learning pathways, real-time feedback, and data-informed decision-making, positioning AI as a strategic tool for improving learning outcomes in contemporary education (Alifah & Hidayat, 2025; Tzirides et al., 2024). In this context, Generation Z students, who dominate current higher education systems, play a critical role. As digital natives, they are highly familiar with technology, prefer interactive and flexible learning environments, and demonstrate strong engagement with digital tools (Toma & Hudea, 2024; Chardonnens,

2025). However, despite their technological familiarity, empirical evidence suggests that their AI literacy and digital competence remain uneven, potentially limiting the effective use of AI in learning (Sari et al., 2025). This indicates that technological exposure alone does not guarantee meaningful learning outcomes.

Learning quality in higher education is a multidimensional construct encompassing cognitive understanding, engagement, critical thinking, and academic performance. Previous studies consistently show that AI utilization can significantly enhance learning quality through personalization, adaptive instruction, and improved feedback mechanisms (Iman et al., 2024; Priamono et al., 2024; Hardini et al., 2025). Additionally, AI-driven analytics and systems have been shown to improve student engagement and academic performance (Foster & Francis, 2020; Alifah & Hidayat, 2025). However, the effectiveness of AI is not universal and depends on several factors, including digital competence, user perceptions, institutional readiness, and pedagogical design (Helmiatin et al., 2024). A growing body of research highlights that digital competence (or AI literacy) is a key determinant of AI utilization. Students with higher digital competence are more likely to adopt and use AI tools effectively, leading to better learning outcomes (Singh et al., 2025; Ahmed, 2025). Digital competence enhances not only technical skills but also critical evaluation and responsible use of AI technologies (Tzirides et al., 2024). Nevertheless, some studies indicate that digital competence alone does not directly translate into improved learning quality unless it is effectively applied through AI utilization (Sari et al., 2025; Ahmed, 2025).

Furthermore, while AI offers substantial benefits, it also presents challenges. Studies reveal that AI can improve performance but may reduce critical thinking and independent reasoning if overused (Balcerzak et al., 2025). Similarly, factors such as perceived risk, stress, ethical concerns, and trust significantly influence AI adoption and its learning effectiveness (Nathanael et al., 2024). These findings suggest that AI should be integrated carefully, combining technological capabilities with pedagogical and human-centered approaches to maximize learning quality (Chardonens, 2025; Tzirides et al., 2024). Despite the growing literature, several research gaps remain. First, most studies on AI in education focus on developed countries, limiting the generalizability of findings to developing contexts such as Indonesia (Helmiatin et al., 2024). Second, many studies emphasize AI adoption or perception, rather than examining its direct impact on learning quality outcomes (Singh et al., 2025). Third, limited research specifically addresses private universities, which face unique challenges such as resource constraints, institutional readiness, and competitive pressures (Hardini et al., 2025).

Moreover, there is insufficient empirical evidence examining the mechanism through which digital competence influences learning quality, particularly the mediating role of AI utilization. Prior studies suggest that AI utilization acts as a critical link between competence and outcomes, transforming students' skills into meaningful learning improvements (Ahmed, 2025; Priamono et al., 2024). However, this mediating relationship remains underexplored, especially among Generation Z students in developing-country contexts. Therefore, this study aims to examine the determinants of AI utilization and its impact on learning quality among Generation Z students in private universities in Bogor City. Specifically, this research seeks to analyze the mediating role of AI utilization in the relationship between digital competence and learning quality, thereby providing empirical insights into how digital skills can be effectively translated into improved educational outcomes through AI integration.

## 2. Literature Review

### 2.1. Digital Competence and AI Literacy in Higher Education

Digital competence, often conceptualized as AI literacy in contemporary contexts, has become a fundamental capability in higher education. It encompasses not only technical skills but also cognitive, ethical, and critical abilities required to effectively engage with digital technologies (Tzirides et al., 2024). In the era of Artificial Intelligence (AI), digital competence enables students to navigate complex learning systems, evaluate information critically, and utilize AI tools responsibly. Empirical studies consistently demonstrate that digital competence is a key predictor of technology adoption. Students with higher levels of digital competence tend to show stronger engagement with AI tools and greater readiness to integrate them into their learning processes (Singh et al., 2025). Similarly, Sari et al. (2025) found that AI literacy among Indonesian students remains relatively low, indicating a significant gap between the availability of technology and students' ability to use it effectively. This gap highlights the importance of strengthening digital competence as a prerequisite for meaningful AI integration in education.

However, the assumption that Generation Z inherently possesses strong digital competence has been critically challenged. While this cohort is highly familiar with digital technologies, their competence is often limited to operational use rather than deeper analytical and academic applications (Toma & Hudea, 2024). This suggests that being a "digital native" does not necessarily equate to being digitally competent in an academic context. Moreover, cultural and contextual factors also shape digital competence, who argue that AI literacy must incorporate ethical reasoning and contextual awareness. Despite its importance, digital competence alone may not directly lead to improved learning outcomes. Ahmed (2025) and Priamono et al. (2024) emphasize that digital competence functions more effectively as an enabling or mediating factor rather than a direct determinant of academic performance. This indicates that digital

competence must be activated through meaningful technological use, particularly AI utilization, to produce measurable improvements in learning quality.

## 2.2. Artificial Intelligence Utilization in Higher Education

AI utilization in higher education refers to the extent to which AI technologies are integrated into teaching and learning processes. These technologies, including intelligent tutoring systems, adaptive learning platforms, learning analytics, and generative AI offer opportunities for personalized learning, real-time feedback, and data-driven decision-making (Ryzheva et al., 2024; Iman et al., 2024). A substantial body of research highlights the positive impact of AI utilization on learning processes. AI-driven systems enhance engagement, support differentiated instruction, and improve learning efficiency by aligning content with individual student needs (Alifah & Hidayat, 2025; Hardini et al., 2025). Additionally, learning analytics and AI tools have been shown to improve academic performance and retention by providing timely interventions and insights (Foster & Francis, 2020). However, AI utilization is not without challenges. Several studies emphasize that its effectiveness depends heavily on user acceptance, institutional readiness, and perceived usefulness (Helmiatin et al., 2024). Factors such as self-efficacy, perceived trust, and perceived risk significantly influence students' intention to adopt AI (Nathanael et al., 2024). These findings suggest that AI utilization is not purely a technological issue but also a behavioral and psychological phenomenon. Moreover, critical perspectives highlight potential negative consequences of AI use. Balcerzak et al. (2025) demonstrate that while AI improves performance, it may reduce cognitive effort and critical thinking, as students shift from active problem-solving to managing AI tools. Similarly, Chardonnens (2025) warns that over-reliance on AI can hinder the development of self-regulation and independent learning skills. These findings underscore the need for a balanced approach that integrates AI with pedagogical strategies rather than relying solely on technological solutions.

## 2.3. Learning Quality in AI-Supported Environments

Learning quality in higher education is a multidimensional construct that includes cognitive achievement, engagement, critical thinking, and learning satisfaction. In AI-supported environments, learning quality is increasingly influenced by the integration of advanced technologies and data-driven instructional approaches. Empirical evidence consistently supports the positive relationship between AI utilization and learning quality. Studies show that AI enhances learning outcomes through personalization, adaptive instruction, and improved feedback mechanisms (Iman et al., 2024; Priamono et al., 2024). Furthermore, AI-based analytics tools improve academic performance and engagement by enabling more targeted, efficient learning processes (Alifah & Hidayat, 2025; Hardini et al., 2025). At the same time, learning quality is also shaped by instructional design and student engagement. Raes et al. (2020) demonstrate that technological environments alone do not guarantee effective learning; rather, engagement and motivation are crucial. Interactive elements such as quizzes and feedback mechanisms significantly enhance learning experiences, highlighting the importance of pedagogical design in AI-supported education. Nevertheless, the relationship between AI and learning quality remains complex. While many studies report positive outcomes, others emphasize the need for more robust and context-specific evidence (Foster & Francis, 2020). This suggests that AI's effectiveness in improving learning quality depends on how it is implemented and integrated into educational practices.

## 2.4. Linking Digital Competence, AI Utilization, and Learning Quality

Recent studies increasingly highlight the interconnected relationship between digital competence, AI utilization, and learning quality. Digital competence enhances students' ability to adopt and use AI technologies effectively, thereby influencing learning outcomes (Singh et al., 2025; Ahmed, 2025). In this context, AI utilization functions as a mechanism that translates digital skills into educational outcomes. Empirical evidence supports this mediating relationship. Ahmed (2025) demonstrates that digital competence significantly mediates the effect of AI-based assessment on student performance. Similarly, Priamono et al. (2024) find that self-competence strengthens the impact of AI on learning outcomes, suggesting that internal capabilities play a crucial role in maximizing AI's benefits. However, this relationship is not always straightforward. Some studies suggest that digital competence does not directly influence learning quality without effective AI utilization (Sari et al., 2025). This finding aligns with the argument that technology must be meaningfully integrated into learning processes to produce significant outcomes. Furthermore, contextual factors such as institutional readiness, cultural context, and access to technology also influence this relationship (Hardini et al., 2025). In developing countries, these factors may create additional barriers that limit the effectiveness of AI integration in education.

Although existing studies provide valuable insights into AI in education, several gaps remain. First, much of the literature focuses on AI adoption and perception, rather than examining its direct impact on learning quality outcomes, particularly in developing-country contexts (Helmiatin et al., 2024). Second, there is limited research exploring the mechanism linking digital competence and learning quality, especially the mediating role of AI utilization. Third, previous

studies often overlook the specific context of private universities, which face unique challenges, including limited resources, institutional constraints, and competitive pressures. These gaps highlight the need for empirical research that integrates digital competence, AI utilization, and learning quality into a comprehensive framework. Based on the synthesis above, this study proposes that digital competence influences AI utilization, which in turn affects learning quality, with AI utilization acting as a mediating variable. This framework provides a more nuanced understanding of how technological capabilities are transformed into meaningful educational outcomes.

## 2.5. Hypothesis Development

### 2.5.1 Digital Competence and Artificial Intelligence Utilization

Digital competence is widely recognized as a critical determinant of technology adoption in higher education, particularly in the context of Artificial Intelligence (AI). It encompasses not only technical skills but also cognitive and critical abilities required to effectively use digital tools (Tzirides et al., 2024). In AI-supported learning environments, students with higher digital competence are better able to understand, evaluate, and use AI-based technologies. Empirical studies consistently demonstrate that digital competence positively influences AI adoption and utilization. For instance, Singh et al. (2025) found that higher levels of AI literacy significantly enhance students' engagement with AI tools, while digital literacy improves perceived ease of use and self-efficacy and drive AI adoption. Similarly, Sari et al. (2025) highlight that limited AI literacy constrains students' ability to effectively use AI technologies in learning. From a theoretical perspective, the Technology Acceptance Model (TAM) suggests that users' competence enhances perceived usefulness and ease of use, thereby increasing actual system utilization. Supporting this view, Ahmed (2025) emphasizes that digital competence is crucial for enabling students to leverage AI tools effectively. Based on these arguments, digital competence is expected to positively influence the use of AI in higher education.

H1: Digital competence has a positive and significant effect on Artificial Intelligence utilization.

### 2.5.2 Digital Competence and Learning Quality

Digital competence is also considered an important factor influencing learning quality, particularly in technology-enhanced learning environments. Students with strong digital competence are better able to access, evaluate, and apply digital information, thereby improving engagement, critical thinking, and academic performance (Toma & Hudea, 2024). Previous studies provide mixed evidence regarding this relationship. On the one hand, research indicates that digital competence enhances learning outcomes by supporting self-regulated learning and effective use of digital resources (Singh et al., 2025). On the other hand, some studies suggest that digital competence alone does not directly lead to significant improvements in learning quality unless it is actively applied through technology use. For example, Sari et al. (2025) found that students' AI literacy remains low despite high exposure to technology, while Ahmed (2025) argues that digital competence functions more as an enabling factor rather than a direct predictor of performance. This inconsistency indicates that the relationship between digital competence and learning quality may not always be direct and may depend on other mediating variables, such as AI utilization. Nevertheless, theoretical and empirical arguments suggest that digital competence is expected to positively influence learning quality.

H2: Digital competence positively affects learning quality.

### 2.5.3 Artificial Intelligence Utilization and Learning Quality

The use of Artificial Intelligence has emerged as a key driver of learning quality in higher education. AI technologies enable personalized learning, adaptive instruction, and real-time feedback, which enhance students' engagement and academic performance (Iman et al., 2024; Alifah & Hidayat, 2025). Empirical evidence consistently supports the positive impact of AI utilization on learning outcomes. Studies show that AI-based systems improve learning effectiveness by tailoring content to individual needs and providing timely feedback (Priamono et al., 2024; Hardini et al., 2025). Furthermore, AI-driven learning analytics have been shown to enhance student engagement and academic achievement (Foster & Francis, 2020). However, some studies also highlight potential limitations. Balcerzak et al. (2025) argue that excessive reliance on AI may reduce critical thinking and cognitive effort, while Chardonnens (2025) emphasizes the need for balanced integration of AI with pedagogical strategies. Despite these concerns, the literature indicates that AI use can improve learning quality when implemented appropriately. Therefore, AI utilization is expected to significantly improve learning quality.

H3: Artificial Intelligence utilization has a positive and significant effect on learning quality.

### 2.5.4 The Mediating Role of Artificial Intelligence Utilization

Recent literature suggests that the relationship between digital competence and learning quality is not always direct but is often mediated by technology utilization. Digital competence enhances students' ability to use AI tools effectively, improving learning outcomes (Singh et al., 2025; Ahmed, 2025). Empirical studies provide strong support

for this mediating mechanism. Ahmed (2025) demonstrates that digital competence significantly mediates the relationship between AI-based assessment and student performance. Similarly, Priamono et al. (2024) find that self-competence strengthens the impact of AI on learning outcomes, indicating that internal capabilities must be activated through technology use. Furthermore, AI use transforms digital skills into meaningful educational outcomes by enabling personalized learning, adaptive instruction, and enhanced engagement (Tzirides et al., 2024; Hardini et al., 2025). Without effective AI utilization, digital competence may remain latent and fail to produce significant improvements in learning quality. Thus, AI use is expected to mediate the relationship between digital competence and learning quality. H4: Artificial Intelligence utilization mediates the relationship between digital competence and learning quality.

### 3. Materials and Methods

This study adopts a quantitative explanatory research design to examine the relationships among digital competence, Artificial Intelligence (AI) utilization, and learning quality among Generation Z students at private universities in Bogor City. Data were analyzed using Structural Equation Modeling (SEM) with LISREL version 8.8, which enables the simultaneous evaluation of both the measurement and structural models, as well as the relationships among latent variables (Hair et al., 2019; Kline, 2023). The study population comprises Generation Z students enrolled in private universities in Bogor City who have experience using AI-based learning technologies. A purposive sampling technique was employed based on the following criteria: (1) active undergraduate students, (2) born in or after 1997, and (3) having prior experience using AI in the learning process. The minimum sample size was determined following SEM guidelines, which recommend five to ten observations per indicator. A total of 220 valid responses were collected, satisfying the minimum sample size requirements and ensuring the reliability and stability of parameter estimation (Hair et al., 2019).

### 4. Results

Table 1 presents the Goodness-of-Fit (GOF) evaluation of the measurement model for the three latent constructs: Digital Competence, Artificial Intelligence (AI) Utilization, and Learning Quality. The assessment is based on several widely accepted fit indices, including GFI, RMSEA, NFI, AGFI, and CFI, each of which is compared against recommended threshold values. The results indicate that the measurement model demonstrates a satisfactory to excellent level of fit, confirming its suitability for further structural analysis.

**Table 1.** Goodness-of-Fit (GOF) Indices

GOF Indicator	Expected Value	Digital Competence	AI Utilization	Learning Quality	Conclusion
GFI	> 0.90	0.93	0.94	0.99	Good Fit
RMSEA	< 0.08	0.065	0.08	0.06	Good Fit
NFI	> 0.90	0.98	0.98	0.98	Good Fit
AGFI	> 0.90	0.91	0.92	0.91	Good Fit
CFI	> 0.90	0.99	0.99	0.98	Good Fit

The Goodness-of-Fit Index (GFI) values for all constructs exceed the recommended threshold of 0.90, with values of 0.93 (Digital Competence), 0.94 (AI Utilization), and 0.99 (Learning Quality). These results suggest that the model explains a high proportion of variance-covariance in the data, indicating strong model adequacy. Second, the Root Mean Square Error of Approximation (RMSEA) values fall within the acceptable range (< 0.08): 0.065, 0.08, and 0.06, respectively. Although the RMSEA value for AI Utilization (0.08) falls at the upper end of the acceptable range, it is still considered adequate, indicating a reasonable approximation error and acceptable model fit. Third, the Normed Fit Index (NFI) values for all constructs are 0.98, which is well above the minimum threshold of 0.90. This indicates that the proposed model provides a significantly better fit compared to a null model, reflecting strong explanatory power. Fourth, the Adjusted Goodness-of-Fit Index (AGFI) values range from 0.91 to 0.92, all exceeding the recommended cutoff of 0.90. This suggests that the model maintains a good level of fit even after adjusting for model complexity, thereby confirming its robustness. Finally, the Comparative Fit Index (CFI) values are exceptionally high, ranging from 0.98 to 0.99. These results indicate an excellent fit of the model relative to an independent baseline model, further reinforcing the validity of the measurement model. This study indicates that all GOF indicators consistently meet or exceed their respective threshold values, demonstrating that the measurement model exhibits a good to excellent fit across all constructs. This confirms that the model is both valid and reliable, and therefore appropriate for subsequent structural model analysis and hypothesis testing.

Table 2 presents the results of hypothesis testing for the direct relationships among digital competence, Artificial Intelligence (AI) utilization, and learning quality. The evaluation is based on path coefficients, standard errors, and *t*-values, with a critical threshold of 1.96 at the 5% significance level.

**Table 2.** Result of Hypothesis Testing for Direct Effect

Hypothesis	Relationship	Coefficient	Std. Error	t-value	Conclusion
H1	Digital Competence → AI Utilization	0.690	0.069	10.060	Supported
H2	Digital Competence → Learning Quality	0.150	0.078	1.930	Not Supported
H3	AI Utilization → Learning Quality	0.570	0.083	6.910	Supported

Table 2 indicates that Digital Competence has a positive and statistically significant effect on AI Utilization (H1). This is evidenced by a path coefficient of 0.690, a relatively small standard error of 0.069, and a high t-value of 10.060, which is far above the critical value. The low standard error suggests that the estimate is highly precise and stable. This finding confirms that students with higher digital competence are significantly more capable of adopting and utilizing AI technologies in their learning processes. The strong coefficient further highlights digital competence as a key determinant of AI utilization in higher education. The relationship between Digital Competence and Learning Quality (H2) is positive but not statistically significant. Although the coefficient is 0.150, indicating a positive direction, the t-value of 1.930 is slightly below the critical threshold of 1.96.

Additionally, the standard error of 0.078 is relatively large compared to the coefficient, indicating lower precision and higher variability in the estimate. This suggests that digital competence alone does not directly lead to significant improvements in learning quality. In other words, possessing digital skills is not sufficient unless they are effectively applied in the learning process. The results show that AI Utilization has a positive and statistically significant effect on Learning Quality (H3). The path coefficient of 0.570, combined with a standard error of 0.083 and a t-value of 6.910, confirms a strong and reliable relationship. Despite the moderate standard error, the high t-value indicates that the effect is robust and statistically meaningful. This finding implies that the use of AI technologies significantly enhances learning quality by enabling personalized learning experiences, improving engagement, and facilitating better academic performance.

The results reveal an important pattern. Digital competence strongly influences AI utilization (H1), and AI utilization significantly improves learning quality (H3), whereas the direct effect of digital competence on learning quality is not significant (H2). This indicates that digital competence contributes to learning quality primarily through the effective use of AI technologies rather than through a direct pathway. These findings highlight the critical role of AI in translating digital competence into improved learning outcomes. Without the application of AI tools, digital competence may remain underutilized and fail to produce significant educational benefits. Therefore, the effectiveness of digital competence in enhancing learning quality depends heavily on how it is operationalized through AI-supported learning environments.

**Table 3.** Result of Hypothesis Testing for Mediating Effect

Hypothesis	Relationship	Coefficient	t-value	Conclusion
H4	Digital Competence → AI Utilization → Learning Quality	0.06	69.515	Supported

Table 3 presents the results of hypothesis testing for the mediating role of Artificial Intelligence (AI) utilization in the relationship between digital competence and learning quality. The findings indicate that the indirect effect of Digital Competence on Learning Quality through AI Utilization (H4) is positive and statistically significant, as reflected by a coefficient of 0.06 and a t-value of 69.515, which is substantially higher than the critical value of 1.96. This result confirms that AI utilization plays a significant mediating role in linking digital competence to learning quality. The positive coefficient suggests that higher levels of digital competence are associated with greater AI utilization, which, in turn, contributes to improvements in learning quality. Although the magnitude of the indirect effect (0.06) is relatively modest compared to the direct effects, its statistical significance indicates that this pathway is meaningful and should not be overlooked. Furthermore, when interpreted alongside the direct effect results (Table 2), this finding provides important insights into the overall structural relationship. While digital competence does not have a significant direct effect on learning quality (H2), it significantly influences AI utilization (H1), which subsequently enhances learning quality (H3). This pattern indicates that AI utilization serves as a crucial mechanism that unleashes the potential of digital competence to improve learning outcomes. In this context, the mediation can be classified as full or indirect-only mediation, as the direct path between digital competence and learning quality is not significant, whereas the indirect path through AI utilization is significant. This suggests that digital competence primarily contributes to learning quality by influencing AI utilization rather than through a direct relationship. This study emphasizes the importance of not only developing students' digital competence but also ensuring that such competence is effectively translated into the practical use of AI technologies in learning environments. Without this mediating mechanism, the impact of digital competence on learning quality may remain limited.

## 5. Discussion

This study aims to examine the relationships among digital competence, Artificial Intelligence (AI) utilization, and learning quality, with a particular focus on the mediating role of AI utilization among Generation Z students in private universities. The findings provide several important theoretical and practical insights when interpreted in light of existing literature. First, the results confirm that digital competence has a positive and significant effect on AI utilization (H1). This finding is consistent with prior studies that emphasize that digital competence, or AI literacy, is a fundamental driver of technology adoption in higher education (Singh et al., 2025). Students with higher levels of digital competence are better able to understand, evaluate, and effectively use AI-based tools in their learning. This aligns with the Technology Acceptance Model (TAM), which suggests that user competence enhances perceived ease of use and usefulness, thereby increasing actual technology utilization (Helmiatin et al., 2024). Furthermore, the strong coefficient observed in this study supports the argument that digital competence is a foundational capability in AI-supported learning environments (Tzirides et al., 2024).

Second, the study finds that digital competence has a positive but not significant effect on learning quality (H2). This result provides an important nuance to the existing literature. While previous studies suggest that digital competence can enhance learning outcomes (Singh et al., 2025), this study indicates that such an effect may not be direct. This finding is consistent with Sari et al. (2025), who reported that although students are highly exposed to digital technologies, their AI literacy remains limited, resulting in suboptimal learning outcomes. Similarly, Ahmed (2025) argues that digital competence functions more as an enabling factor rather than a direct determinant of performance. This suggests that digital competence alone is insufficient to improve learning quality unless it is actively operationalized within the learning process. In other words, the mere possession of digital skills does not guarantee improved academic outcomes without meaningful application.

Third, the results demonstrate that AI utilization has a positive and significant effect on learning quality (H3). This finding is strongly supported by a wide body of literature highlighting AI's transformative role in education. AI technologies facilitate personalized learning, adaptive instruction, and real-time feedback, all of which contribute to improved student engagement and academic performance (Iman et al., 2024; Alifah & Hidayat, 2025; Hardini et al., 2025). Additionally, AI-driven learning analytics have been shown to enhance learning outcomes by enabling data-informed instructional decisions (Foster & Francis, 2020). The relatively strong coefficient observed in this study confirms that AI use is a key driver of learning quality in higher education, particularly for Generation Z students who prefer interactive, technology-mediated learning environments (Chardonens, 2025).

However, this study also acknowledges critical perspectives from prior research. For instance, Balcerzak et al. (2025) highlight that while AI improves performance, it may reduce cognitive effort and critical thinking if over-relied upon. Similarly, Nathanael et al. (2024) emphasize that factors such as perceived risk, stress, and ethical concerns can influence the effectiveness of AI in learning. These insights suggest that although AI use enhances learning quality, its effectiveness depends on balanced, responsible implementation supported by appropriate pedagogical strategies (Tzirides et al., 2024). Most importantly, this study confirms that AI utilization plays a significant mediating role in the relationship between digital competence and learning quality (H4). This finding provides a deeper understanding of the mechanism through which digital competence influences learning outcomes. Specifically, digital competence enhances students' ability to use AI technologies, thereby improving learning quality. This result is consistent with Ahmed (2025) and Priamono et al. (2024), who found that competence-related factors significantly mediate the impact of technology on learning performance. The mediation result also explains why the direct effect of digital competence on learning quality is not significant because its influence is primarily indirect and operates through AI utilization.

## 6. Conclusions

This study investigates the relationships among digital competence, Artificial Intelligence (AI) utilization, and learning quality, with a particular focus on the mediating role of AI utilization among Generation Z students in private universities in Bogor City. The findings provide several important conclusions. First, the results confirm that digital competence has a positive and significant effect on AI utilization, indicating that students' technological capabilities are a key determinant of their ability to adopt and use AI-based learning tools. Second, digital competence shows a positive but not significant direct effect on learning quality, suggesting that digital skills alone are insufficient to produce meaningful improvements in learning outcomes. Third, AI utilization has a positive, significant effect on learning quality, demonstrating that effective AI use plays a crucial role in enhancing student engagement, personalization, and academic performance. Most importantly, this study finds that AI utilization acts as a significant mediating variable in the relationship between digital competence and learning quality. This indicates that digital competence primarily improves learning outcomes by influencing AI utilization rather than through a direct pathway. In other words, the value of digital competence lies in its ability to enable students to effectively use AI technologies to enhance learning quality.

## 6.1. Research Limitations

Despite its contributions, this study has several limitations. First, the research is limited to private universities in Bogor City, which may restrict the generalizability of the findings to other regions or institutional contexts. Second, the use of a cross-sectional design limits the ability to capture causal relationships and long-term effects of AI utilization on learning quality. Third, the study relies on self-reported data, which may be subject to response bias and may not fully reflect actual behavior. Fourth, this study focuses on a limited set of variables, namely digital competence, AI utilization, and learning quality, while other potentially relevant factors, such as institutional support, lecturer readiness, and technological infrastructure, were not included.

## 6.2. Research Implications

### 6.2.1. Implications for Theory

This study contributes to the existing literature by providing a comprehensive, integrated framework that links digital competence, AI utilization, and learning quality. It extends prior research by demonstrating that the relationship between digital competence and learning quality is indirect and mediated by AI utilization, thereby offering a more nuanced understanding of how technological capabilities translate into educational outcomes. This finding enriches the theoretical discourse by positioning AI utilization as a key mechanism in technology-enhanced learning, rather than merely a contextual variable. Furthermore, the study provides empirical evidence from a developing-country context, which remains underexplored in the literature on AI in higher education.

### 6.2.2. Implications for Practice and Policy

From a practical perspective, the findings highlight the importance of not only developing students' digital competence but also ensuring that such competence is effectively translated into active AI utilization in learning environments. Higher education institutions should design curricula that integrate AI tools into teaching and learning processes, enabling students to apply their digital skills in meaningful ways. From a policy perspective, universities and policymakers should prioritize:

1. Digital competence development programs, focusing on both technical and critical skills
2. Integration of AI-based learning systems, such as adaptive platforms and learning analytics
3. Capacity building for lecturers, ensuring they are equipped to incorporate AI into pedagogy
4. Ethical and responsible AI use policies, addressing issues such as data privacy and over-reliance on AI

Additionally, investment in technological infrastructure and institutional readiness is essential to maximize the benefits of AI in education. Policymakers should also ensure equitable access to AI technologies to reduce digital disparities among students.

## 6.3. Future Research

Future studies are encouraged to adopt longitudinal designs to better understand the long-term impact of AI utilization on learning quality. Expanding the research to include different institutional contexts and countries would enhance the generalizability of the findings. Moreover, future research could incorporate additional variables, such as learning motivation, institutional support, and technological readiness, to provide a more comprehensive understanding of AI integration in education.

**Author Contributions:** Conceptualization, J.S. and T.R.; methodology, J.S.; software, J.S.; validation, T.R.; formal analysis, J.S.; investigation, J.S.; resources, J.S.; data curation, T.R.; writing—original draft preparation, J.S.; writing—review and editing, T.R.; visualization, J.S.; supervision, T.R.; project administration, T.R.; funding acquisition, T.R. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The data that support the findings of this study are available from the corresponding author upon reasonable request.

**Acknowledgments:** The authors would like to thank Pakuan University, Bogor, Indonesia, for supporting this research publication. We also thank the reviewers for their constructive comments and suggestions.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

- Ahmed, R. (2025). Artificial intelligence-based assessment and student performance: The mediating role of digital competence in the university context. *Journal of Research, Innovation, and Strategies for Education (RISE)*, 2(5), 18–35.
- Alifah, N., & Hidayat, A. R. (2025). Effectiveness of artificial intelligence-based learning analytics tool in supporting personalized learning in higher education. *Jurnal Pendidikan Progresif*, 15(1), 74–84.
- Balcerzak, A. P., Zinecker, M., & Mičánek, J. (2025). The impact of artificial intelligence on task performance and decision-making: Empirical evidence on Generation Z. *Human Technology*, 21(3), 620–639.
- Chardonens, S. (2025). Adapting educational practices for Generation Z: Integrating metacognitive strategies and artificial intelligence. *Frontiers in Education*, 10, 1504726.
- Foster, C., & Francis, P. (2020). A systematic review on the deployment and effectiveness of data analytics in higher education to improve student outcomes. *Assessment & Evaluation in Higher Education*, 45(6), 822–841.
- Hardini, M., Hetilaniar, H., Girsang, S. E. E., Putra, S. N. W., & Hikam, I. N. (2025). Advancing higher education: Longitudinal study on AI integration and its impact on learning. *International Journal of Cyber and IT Service Management*, 5(1), 23–30.
- Helmiatin, H., Hidayat, A., & Kahar, M. R. (2024). Investigating the adoption of AI in higher education: A study of public universities in Indonesia. *Cogent Education*, 11(1), 2380175.
- Iman, M. Z., Asis, A. A., & Rahma, A. U. Z. (2024). Enhancing personalized learning: The impact of artificial intelligence in education. *Edu Spectrum: Journal of Multidimensional Education*, 1(2), 101–112.
- Kline, R. B. (2023). *Principles and practice of structural equation modeling* (5th ed.). Guilford Press.
- Nair, R. (2024). Incorporation of deep learning-based AI tools in education: A statistical evaluation of the perceptions of Gen-Z and Millennials. In D. Hack-Polay, D. Lock, A. Caputo, M. Lokhande, & U. Salunkhe (Eds.), *Global higher education practices in times of crisis: Questions for sustainability and digitalization*. Emerald Publishing. <https://doi.org/10.1108/978-1-83797-052-020241013>
- Nathanael, A., Wijaya, D., & Orlando, L. (2024). The implications of utilizing AI for learning on Generation Z. In *2024 International Seminar on Intelligent Technology and Its Applications (ISITIA)* (pp. 442–447). IEEE.
- Priamono, G. H., Hakim, A. R., & Daryono, R. W. (2024). The influence of artificial intelligence and mobile learning on learning outcomes in higher education: Did the mediation of self-competence matter. *Jurnal Penelitian dan Pengkajian Ilmu Pendidikan: E-Saintika*, 8(2), 241–259.
- Raes, A., Vanneste, P., Pieters, M., Windey, I., Van Den Noortgate, W., & Depaepe, F. (2020). Learning and instruction in the hybrid virtual classroom: An investigation of students' engagement and the effect of quizzes. *Computers & Education*, 143, 103682.
- Ryzheva, N., Nefodov, D., Romanyuk, S., Marynchenko, H., & Kudla, M. (2024). Artificial intelligence in higher education: Opportunities and challenges. *Revista Amazonia Investiga*, 13(73), 284–296.
- Sari, D. K., Supahar, S., Rosana, D., Dinata, P. A., & Istiqlal, M. (2025). Measuring artificial intelligence literacy: The perspective of Indonesian higher education students. *Journal of Pedagogical Research*, 9(2), 143–157.
- Singh, E., Vasishta, P., & Singla, A. (2025). AI-enhanced education: Exploring the impact of AI literacy on generation Z's academic performance in Northern India. *Quality Assurance in Education*, 33(2), 185–202.
- Toma, S. G., & Hudea, O. S. (2024). Generation Z students' perceptions on the abilities, skills and competencies required in the age of artificial intelligence systems. *Amfiteatru Economic*, 26(65), 162–180.
- Tzirides, A. O. O., Zapata, G., Kastania, N. P., Saini, A. K., Castro, V., Ismael, S. A., & Kalantzis, M. (2024). Combining human and artificial intelligence for enhanced AI literacy in higher education. *Computers and Education Open*, 6, 100184.