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# ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION: STUDENT COMPETENCIES AND PROFESSIONAL READINESS IN TECHNOLOGY- DRIVEN ENVIROMENTS

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## ABSTRACT

Artificial Intelligence (AI) is increasingly integrated into higher education. However, its effectiveness in enhancing student competencies and professional readiness remains uncertain. This study examines the extent to which AI adoption contributes to the development of key competencies and professional readiness among Generation Z students at Universiti Utara Malaysia (UUM). A mixed-methods approach was employed involving 150 undergraduate students, supported by semi-structured interviews with 10 lecturers and student representatives. The study is guided by a conceptual framework linking AI adoption to critical thinking, digital literacy, ethical reasoning, and professional readiness. Findings indicate a moderate level of AI adoption, with students primarily using AI tools for productivity and assignment preparation, while engagement in creative and innovative applications remains limited. Although digital literacy shows improvement, enhancements in critical thinking and ethical awareness are less evident. Qualitative findings further reveal a tendency among students to over-reliance on generative AI outputs without critically evaluating accuracy, bias, or reliability. Lecturers also expressed concerns regarding the absence of structured AI pedagogy and clear institutional guidelines governing AI use in academic settings. In addition, only a small proportion of students demonstrated confidence in applying AI within professional contexts such as urban planning and related fields. Overall, the study concludes that AI adoption alone does not guarantee the development of meaningful competencies or professional readiness. It emphasizes the need for curriculum enhancement, clearer institutional policies, and targeted capacity-building initiatives that integrate AI literacy, ethical considerations, and discipline-specific applications to ensure responsible, critical, and effective use of AI among future graduates in complex professional environments.

**Keywords**: Artificial Intelligence (AI); higher education; student competencies; professional readiness; urban planning.

## INTRODUCTION

Artificial Intelligence (AI) is rapidly transforming the landscape of higher education worldwide, reshaping traditional approaches to teaching, learning, and assessment. Once confined to the domain of computer science, AI has now permeated nearly every academic discipline, serving as a catalyst for pedagogical innovation and institutional change. AI tools today range from automated grading and plagiarism detection systems to adaptive learning platforms and generative applications such as ChatGPT and Bard. These tools provide students with unprecedented access to information, enable personalized learning experiences, and foster the acquisition of digital competencies aligned with the demands of the Fourth Industrial Revolution (IR 4.0). For Generation Z students, often described as "digital natives," AI has become an integral part of their academic, social, and professional environments. Having grown up with smartphones, high-speed connectivity, and algorithm-driven platforms, this generation demonstrates both enthusiasm and dependence on AI-based technologies. While the widespread adoption of AI creates opportunities to expand digital learning and improve academic productivity, it also raises concerns about students' critical thinking, ethical reasoning, and overreliance on AI-generated content.

Despite the growing use of AI in higher education, there remains a limited understanding of whether AI adoption genuinely contributes to the development of meaningful student competencies and professional readiness. Existing studies mainly focus on the functional benefits of AI in classroom settings, with less attention given to how AI affects critical thinking, ethical awareness, and preparedness for technology-driven professional fields. This gap highlights the need for further investigation into how Generation Z students engage with AI and whether such engagement adequately prepares them for future professional challenges. Existing scholarship has identified numerous benefits of AI adoption in education. Studies highlight gains in personalized learning, enhanced student autonomy, efficient feedback systems, and the development of higher-order skills such as critical thinking and problem-solving (Dwivedi et al., 2023; Zawacki-Richter et al., 2019). For instance, adaptive learning platforms allow differentiated instruction that meets students at their individual levels of preparedness, while generative AI supports creativity and exploration of new ideas. These applications resonate with UNESCO's (2023) call for flexible, technology-driven education models that address diverse learning needs in the era of IR 4.0.

Despite these promises, literature also raises cautionary perspectives. Concerns about academic integrity, originality, and ethical reasoning are pervasive. Generative AI tools blur boundaries between authentic student work and algorithmically generated content, challenging long-standing norms of authorship and assessment. Moreover, overreliance on AI may encourage surface-level learning rather than cultivating deep understanding and reflective judgment. Ethical issues such as bias, data privacy, and algorithmic opacity add further complexity (Kasneci et al., 2023; Mbakwe et al., 2023). These debates underscore the dual reality of AI in higher education: it is both an enabler of learning and a source of pedagogical and ethical challenges. Professional Context: Urban Planning and Smart Cities is beyond the classroom; AI's influence is profoundly evident in professional fields, particularly urban planning and smart city governance. Planners increasingly rely on AI-driven tools for spatial data analysis, land-use modeling, traffic simulation, and environmental monitoring (Batty, 2021; Bibri, 2022). Smart cities, characterized by the integration of digital infrastructure and AI-based management

systems, exemplify how AI mediates urban life from energy optimization to citizen engagement. For professionals in this field, technical competence in AI is necessary but insufficient. Urban planners must also exercise ethical reasoning, critical judgment, and sensitivity to social equity, since AI-driven planning decisions can inadvertently reinforce inequalities or infringe upon privacy (Yigitcanlar et al., 2020). The convergence of technical and ethical competencies in urban planning provides a valuable lens for examining how AI adoption in higher education translates into professional readiness.

In the Malaysian Context, higher education is undergoing rapid digital transformation in response to both global pressures and national policy agendas such as the Malaysia Education Blueprint (2015–2025) and MyDIGITAL initiative. Universities are increasingly expected to embed digital literacy and innovation into their programs to prepare graduates for future workforce demands. However, the policy and curricular integration of AI remain uneven. While some institutions have embraced AI literacy workshops and research-driven applications, others lag in developing structured guidelines for responsible AI use, leaving students to navigate adoption largely on their own. This context provides both urgency and relevance to examining how Generation Z students at Universiti Utara Malaysia (UUM) adopt AI in their studies, how such adoption shapes their academic competencies, and whether it equips them for emerging professional challenges. By sitting in AI use within both educational and professional trajectories, this study helps bridge a critical gap in existing literature. The research gap and rationale are that most research on AI in higher education has focused narrowly on classroom applications, grading efficiency, tutoring systems, or plagiarism detection, without fully addressing how AI adoption contributes to broader competencies and professional readiness. Very few studies explore the intersection between AI adoption in higher education and its implications for specialized professional domains such as urban planning and smart city governance, where both technical proficiency and ethical responsibility are paramount. This study addresses that gap by investigating AI adoption among Generation Z students at UUM, examining not only their learning practices but also their preparedness to engage with AI in professional contexts. The study takes an interdisciplinary approach, recognizing that higher education must not only impart knowledge but also prepare students to operate in technology-driven, ethically contested, and socially impactful professions.

The research question is to strengthen the methodological coherence of this mixed-methods study. The following research questions are proposed: What is the extent of AI adoption among Generation Z students in higher education? What are the perceived benefits and challenges of AI use among Generation Z students, particularly in relation to critical thinking, digital literacy, and academic integrity? Is there a significant relationship between AI adoption and the development of student competencies such as critical thinking, digital literacy, and ethical reasoning? To what extent does AI adoption contribute to students' professional readiness, particularly in fields related to urban planning and smart city development? The study also proposes the following hypotheses:

H1: There is a significant relationship between AI adoption and students' digital literacy.
H2: There is a significant relationship between AI adoption and students' critical thinking skills.
H3: Adoption of AI significantly influences students' professional readiness in technology-driven fields.

The objective of the study is to identify and examine the role of Artificial Intelligence (AI) in shaping students' learning experiences, competencies, and preparedness for future professional practice in a technology-driven educational environment is to assess the extent of AI adoption among Generation Z students in higher education. Evaluate the perceived benefits and challenges of AI use, particularly in relation to critical thinking, digital literacy, and academic integrity. Explore the implications of AI

adoption for professional readiness, with emphasis on urban planning and smart city development, where technological and ethical competencies are essential. This study is significant because it deepens understanding of Artificial Intelligence (AI) in higher education by examining its broader impact on student competencies, interdisciplinary applications, and implications for policy and curriculum development. The study offers three contributions: it extends the literature on AI in higher education by moving beyond efficiency gains to assess how AI adoption shapes competencies such as critical thinking, digital literacy, and ethical reasoning. It strengthens the interdisciplinary link between education and urban planning, highlighting the relevance of AI for professional domains such as spatial analytics, smart city governance, and sustainability assessment. It provides policy and curriculum insights for Malaysian and global universities, underscoring the need to embed AI literacy and ethical frameworks into programs to ensure that Generation Z graduates are not only proficient users of AI but also socially responsible and professionally prepared.

## LITERATURE REVIEW

### AI in Higher Education: Learning, Assessment, and Ethics

The integration of Artificial Intelligence (AI) into higher education has accelerated over the past decade, reshaping pedagogical practices, modes of assessment, and institutional governance. AI-powered adaptive learning platforms provide personalized pathways by tailoring instructional content to students' prior knowledge, learning pace, and preferred styles (Holmes et al., 2021). Such systems demonstrate AI's potential to enhance inclusive education and improve access to learning. Similarly, automated assessment tools, including essay grading systems, plagiarism detection software, and predictive analytics, contribute to efficiency and timely feedback, thereby enhancing student performance (Luckin et al., 2016; Williamson & Eynon, 2020). However, findings are mixed regarding the educational impact of AI. While some studies report on improved engagement and autonomy (Zawacki-Richter et al., 2019), others argue that excessive reliance on AI tools may reduce deep cognitive engagement and weaken students' independent problem-solving skills (Chiu, 2024; Kasneci et al., 2023). This suggests a tension between efficiency-oriented learning and competency-based development. These innovations align with the Fourth Industrial Revolution (IR 4.0), where education systems are expected to become more flexible and technology-driven (UNESCO, 2023). Nevertheless, scholars such as Selwyn (2023) argue that AI integration often prioritizes technological efficiency over pedagogical depth, creating a gap between tool usage and meaningful learning outcomes. In addition, ethical concerns surrounding AI are widely documented. Issues such as academic integrity, data privacy, algorithmic bias, and authorship ambiguity are increasingly prominent (Kasneci et al., 2023; Mbakwe et al., 2023). Comparative studies indicate that institutions in developed countries have more structured AI governance frameworks, while universities in developing regions still face policy fragmentation and limited AI literacy training (Tan et al., 2024; Zawacki-Richter et al., 2019). This highlights a global disparity in AI readiness in higher education.

### AI in Professional Fields: Urban Planning and Smart Cities

AI is also transforming professional domains, particularly urban planning and smart city governance. Applications include geospatial modelling, land-use prediction, traffic optimization, and environmental monitoring (Batty, 2021; Bibri, 2022). These tools improve decision-making efficiency and support sustainable urban development. However, research findings differ regarding the implications of AI in planning practice. While some scholars highlight improved efficiency and predictive accuracy (Batty,

2021), others caution that AI may reinforce spatial inequality and surveillance risks if used without ethical oversight (Kitchin, 2021; Yigitcanlar et al., 2020). This contrast illustrates that AI is not value-neutral but shaped by governance and human interpretation. In smart city contexts, AI enables real-time infrastructure management and citizen engagement systems. Yet, critical studies emphasize that technological advancement alone does not guarantee equitable urban outcomes unless supported by strong ethical and governance frameworks (Bibri, 2022; Yigitcanlar et al., 2020). Therefore, professional readiness in urban planning requires both technical AI competence and ethical reasoning skills. This dual requirement creates a direct connection between higher education outcomes and real-world professional performance.

**Student Readiness and Generation Z Competencies**

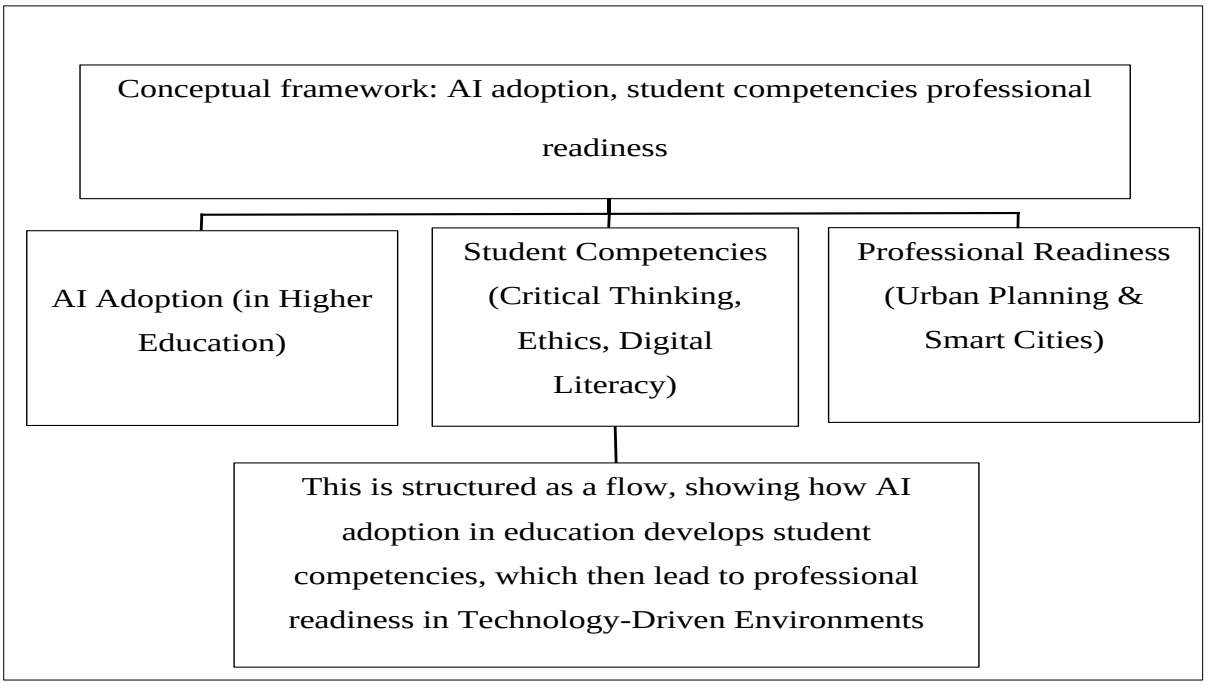
Generation Z students, as digital natives, demonstrate strong familiarity with digital technologies and AI tools. They frequently use AI for summarization, idea generation, and academic tasks (Seemiller & Grace, 2019). Studies show that Gen Z learners tend to adopt AI more quickly than previous generations due to greater digital exposure and platform-based learning habits (Dwivedi et al., 2023). However, contradictory evidence suggests that high adoption does not necessarily translate into deep learning competencies. While students are proficient in using AI tools, they often lack critical evaluation skills, ethical awareness, and the ability to assess the validity of information (Chiu, 2024; Dwivedi et al., 2023). Comparative research across disciplines also indicates that students in applied fields (example, engineering, planning) show higher AI utilization but not necessarily higher ethical awareness than students in the humanities, suggesting uneven competency development across academic domains (Williamson & Eynon, 2020). For disciplines such as urban planning, these gaps are particularly significant because professional decisions directly affect society and the environment. Thus, student readiness must be understood as a multidimensional construct involving digital literacy, critical thinking, and ethical reasoning rather than mere technological proficiency.

**Conceptual Framework: AI Adoption, Student Competencies, and Professional Readiness**

The conceptual framework of this study illustrates the relationship between AI adoption, student competencies, and professional readiness. AI adoption alone does not automatically lead to professional readiness. Instead, its impact is mediated by student competencies such as critical thinking, digital literacy, and ethical reasoning. Empirical studies provide mixed evidence regarding this relationship. Some research suggests that AI enhances learning efficiency and cognitive support (Holmes et al., 2021), while others argue that without guided pedagogical integration, AI may lead to dependency and reduced independent thinking (Kasneci et al., 2023; Selwyn, 2023). In this framework, competencies act as a critical mediating mechanism. Students who develop strong analytical and ethical skills are more likely to translate AI usage into meaningful professional readiness, particularly in fields such as urban planning and smart city governance. Thus, the relationship between AI adoption and professional readiness is not linear but conditional, depending on the quality of competency development within higher education institutions.

**Figure 1**

*Conceptual Framework of AI Adoption, Student Competencies, and Professional Readiness*




This framework illustrates the relationship between AI adoption in higher education, student competencies, and professional readiness in fields such as urban planning and smart city development. AI adoption provides students with exposure to digital tools that enhance learning efficiency and academic performance. However, its influence on professional readiness is not direct but is instead mediated by the development of key competencies. These competencies, particularly critical thinking, ethical reasoning, and digital literacy, serve as the mediating mechanism that determines whether AI use translates into meaningful professional capability. In practice-oriented disciplines such as urban planning, where decisions carry significant societal and environmental implications, the ability to apply AI responsibly is essential. The framework, therefore, conceptualizes AI adoption as an enabling factor, student competencies as a mediating mechanism, and professional readiness as the outcome. This model emphasizes a non-linear relationship, in which the effectiveness of AI integration in higher education depends on the quality of competency development rather than on technology exposure alone.

## METHODOLOGY

This study employed a convergent mixed-methods design, integrating both quantitative and qualitative approaches to ensure a comprehensive understanding of AI adoption among Generation Z students in higher education and its implications for professional readiness. The design was informed by the conceptual framework (Figure 1), which positions AI Adoption as the input, Student Competencies (critical thinking, ethical reasoning, digital literacy) as the mediating factor, and Professional Readiness as the outcome. The rationale for a mixed-methods approach lies in its ability to triangulate findings: survey data capture measurable trends and associations, while interviews provide rich narratives that contextualize the results. Both quantitative and qualitative data were collected concurrently within the same data collection period. The two datasets were initially analyzed separately and subsequently

merged during the interpretation of findings. This approach strengthens the validity and depth of the overall interpretation phase for identifying convergence, divergence, and complementarity.

A structured questionnaire was administered to 150 undergraduate students enrolled in social sciences and applied disciplines at Universiti Utara Malaysia (UUM). Participants were selected using a stratified random sampling technique, based on Year 1, Year 2, Year 3, and Year 4 study levels to ensure proportional representation across academic cohorts. The sample size of 150 respondents was determined using Krejcie and Morgan's (1970) sampling table, which is widely accepted for determining minimum sample sizes in quantitative social science research, ensuring sufficient statistical reliability for correlation and regression analyses. The survey consisted of 30 Likert-scale items (1 = strongly disagree to 5 = strongly agree), structured into three constructs: AI Adoption: Frequency of AI tool use (e.g., ChatGPT, Grammarly, GIS-based AI tools), purpose (academic writing, data analysis, design tasks), and perceived benefits (efficiency, accessibility, creativity support). Student Competencies: Self-assessment of critical thinking, ethical reasoning (e.g., plagiarism awareness, bias recognition), and digital literacy (technical proficiency, responsible usage). Professional Readiness: Perceptions of how AI supports career preparation, particularly in urban planning, smart governance, and digital innovation fields.

The questionnaire items were adapted from established and validated instruments in previous studies on technology acceptance, digital literacy, and AI in education. Minor modifications were made to align the items with the Malaysian higher education context and Generation Z learners. Content validity was reviewed by three experts in educational technology and social science research. A pilot study involving 20 students (excluded from the final sample) was conducted to assess clarity, reliability, and comprehensibility of the instrument. Based on pilot feedback, several items were refined for clarity. Reliability testing using Cronbach's alpha confirmed acceptable internal consistency for all constructs ($\alpha > 0.70$).

The questionnaire was distributed electronically using Google Forms to facilitate accessibility and wider participation. Data collection was conducted over a four-week period (Week 3 to Week 6 of the semester). Recruitment was carried out through official university email lists, lecturers, and faculty coordinators. Participation was voluntary, and reminder messages were issued weekly to improve response rates.

Semi-structured interviews were conducted with 10 participants, consisting of five lecturers and five student representatives. Participants were selected using purposive sampling based on two criteria: (i) direct experience with AI tools in teaching or learning, and (ii) relevance to disciplines such as urban planning, smart cities, education, and technology-related fields. Interview participants were recruited through departmental recommendations and student organization referrals. They were contacted through official communication platforms such as WhatsApp. The interviews explored: experiences of AI integration in teaching and learning; development of student competencies (critical thinking, ethics, digital literacy); and perceptions of AI's relevance to future professional careers, particularly in urban planning, smart cities, and governance. Interviews lasted 45–60 minutes, were audio-recorded with consent, transcribed verbatim, and anonymized to ensure confidentiality.

The data analysis consists of two types: quantitative and qualitative. The Survey data were analyzed using SPSS software. Descriptive statistics were used to summarize AI usage patterns and competency levels. Pearson correlation analysis was conducted to examine relationships between AI adoption, student competencies, and professional readiness. Where appropriate, multiple regression analysis was

performed to identify predictive relationships among variables. Interview transcripts were analyzed using NVivo software following Braun and Clarke's (2006) thematic analysis approach. The analysis involved familiarization with data, generating initial codes, searching for themes, reviewing themes, and defining final themes. Coding was conducted using a combination of inductive and deductive approaches guided by the conceptual framework (AI Adoption, Student Competencies, Professional Readiness).

The integration of quantitative and qualitative data aligns with the convergent mixed-methods design; both datasets were integrated during the interpretation phase. Integration was conducted using a side-by-side comparison method, where quantitative results were directly compared with qualitative themes. A joint display analysis was developed to align statistical trends with qualitative insights, enabling clearer interpretation of how AI adoption influences student competencies and professional readiness. This triangulation process enhances the validity, depth, and interpretive strength of the findings.

The ethical consideration is that ethical approval was obtained from the university research ethics committee prior to data collection. All participants were provided with an information sheet and an informed consent form. Participation was voluntary, and respondents were informed of their right to withdraw at any stage without penalty. Confidentiality was strictly maintained through data anonymization, and all digital records were securely stored on password-protected devices accessible only to the researcher. Data was used solely for academic research purposes. In addition, special attention was given to minimizing any potential psychological or academic risk to participants throughout the study. The questionnaire and interview questions were designed to be non-invasive, avoiding sensitive or distressing topics. Participants were encouraged to respond honestly without fear of judgment or academic consequences, thereby reducing response bias and promoting data integrity. To further uphold ethical standards, no personal identifiers, such as names, matric numbers, or contact details, were collected during data collection. Instead, each respondent was assigned a unique identification code for analysis purposes. Moreover, all data handling procedures complied with institutional data protection guidelines and relevant national research ethics standards. Any printed materials containing raw data were securely locked in a cabinet when not in use. Upon completion of the study, all identifiable or raw datasets will be permanently deleted or destroyed in accordance with ethical disposal protocols. The researcher also ensured transparency by clearly explaining the study's aims and procedures to all participants before their involvement, thereby fostering trust and informed participation. These measures collectively ensured that the study adhered to the highest ethical standards in social science research.

## RESULTS AND DISCUSSIONS

### AI Adoption in Higher Education

The survey results reveal that AI adoption among Generation Z students at UUM is moderate but steadily increasing, consistent with the global expansion of generative and task-oriented AI applications in higher education. Usage patterns varied across students' academic programs, semester of study, and individual learning objectives, indicating that AI adoption is not uniform but shaped by contextual and disciplinary factors.

**Table 1**

*AI Adoption Patterns among UUM Students (N = 150)*

| AI Usage Dimension | High (%) | Moderate (%) | Low (%) |
|---|---|---|---|
| Assignment preparation | 52.0 | 38.0 | 10.0 |
| Exam revision/self-learning | 47.3 | 35.3 | 17.4 |
| Productivity (time management) | 65.0 | 25.0 | 10.0 |
| Creative/innovative tasks | 28.0 | 40.7 | 31.3 |

*Source.* Research Findings, 2026

Students reported higher reliance on AI for efficiency-driven tasks, particularly productivity management (65% high use) and assignment preparation (52%). These results align with global studies showing that AI is frequently used to simplify repetitive academic tasks such as summarization, information retrieval, and scheduling (Zawacki-Richter et al., 2019). In contrast, only 28% reported high AI usage for creative and innovative activities, suggesting that students remain hesitant to utilize AI for higher-order cognitive engagement such as problem-solving, idea generation, and design thinking.

**Table 2**

*Reliability Analysis for AI Adoption Scale*

**Reliability**

**Scale: AI Adoption**

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 150 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 150 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .927 | 10 |

*Source.* Research Findings, 2026

**Table 3**

*Reliability Analysis for Professional Readiness*

**Reliability**

**Scale: Professional Readiness**

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 150 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 150 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .893 | 10 |

*Source.* Research Findings, 2026.

**Table 4**

*Descriptive Statistics of AI Adoption Variables*

**Descriptives**

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean |
|---|---|---|---|---|
| Mean AI Adoption score | 150 | 1.0000000000 00000 | 5.0000000000 00000 | 3.3940000000 00001 |
| Mean Student Competencies score | 150 | 1.0000000000 00000 | 5.0000000000 00000 | 3.1613333333 33334 |
| Mean Professional Readiness score | 150 | 1.0000000000 00000 | 5.0000000000 00000 | 3.1766666666 66667 |
| Valid N (listwise) | 150 | | | |

**Descriptive Statistics**

| | Std. Deviation |
|---|---|
| Mean AI Adoption score | 1.0452981977 15681 |
| Mean Student Competencies score | .99081599255 1693 |
| Mean Professional Readiness score | .99525158983 5129 |
| Valid N (listwise) | |

*Source. Research Findings, 2026.*

To strengthen the study's empirical robustness, Pearson correlation analysis was conducted to examine the relationship between AI adoption and student competencies. The analysis revealed a statistically significant positive relationship between AI adoption and student competencies ($r = 0.672$, $p < 0.001$). This indicates that higher levels of AI usage are associated with stronger development of competencies such as digital literacy, critical thinking, and ethical awareness. The strength of the correlation can be interpreted as moderate to strong, suggesting that AI adoption contributes meaningfully to students'

competency enhancement. Furthermore, multiple regression analysis demonstrated that AI adoption significantly predicts professional readiness among students ($\beta = 0.58$, $t = 7.84$, $p < 0.001$). The regression model explained approximately 46% of the variance in professional readiness ($R^2 = 0.46$), indicating that AI adoption plays a substantial role in shaping students' confidence toward future employability and technology-related careers. Qualitative interviews reinforced these quantitative findings. Students expressed that AI helped them "save time" and "make studying more manageable," while lecturers observed that students frequently depended on AI-generated outputs without engaging critically with the information provided. This reflects broader debates concerning the tension between efficiency and meaningful engagement in learning (Dwivedi et al., 2023). Lecturers also expressed concerns regarding over-reliance on generative AI tools such as ChatGPT in academic writing and the absence of clear institutional policies governing ethical AI use.

**Development of Student Competencies**

The second dimension investigated whether AI adoption translated into competency development, focusing on critical thinking, digital literacy, and ethical awareness.

**Table 5**

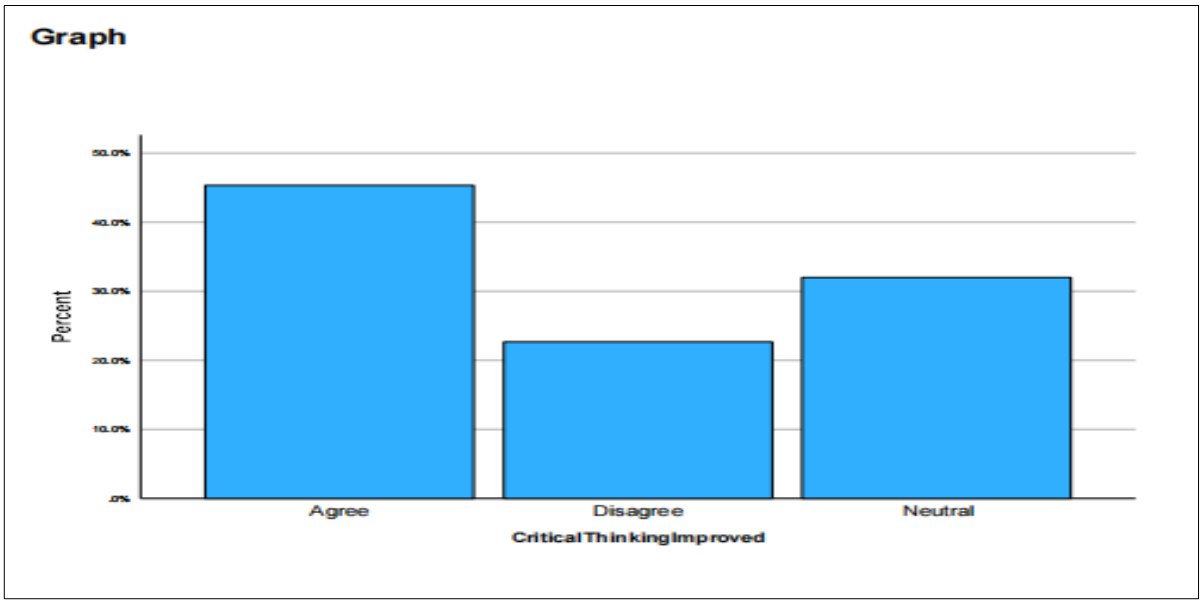
*Student Perceptions of Competency Development*

| Competency Area | Agree (%) | Neutral (%) | Disagree (%) |
|---|---|---|---|
| Critical thinking improved | 45.3 | 32.0 | 22.7 |
| Digital literacy improved | 70.7 | 20.0 | 9.3 |
| Ethical awareness improved | 38.0 | 36.0 | 26.0 |

*Source.* Research Findings, 2026.

**Figure 2**

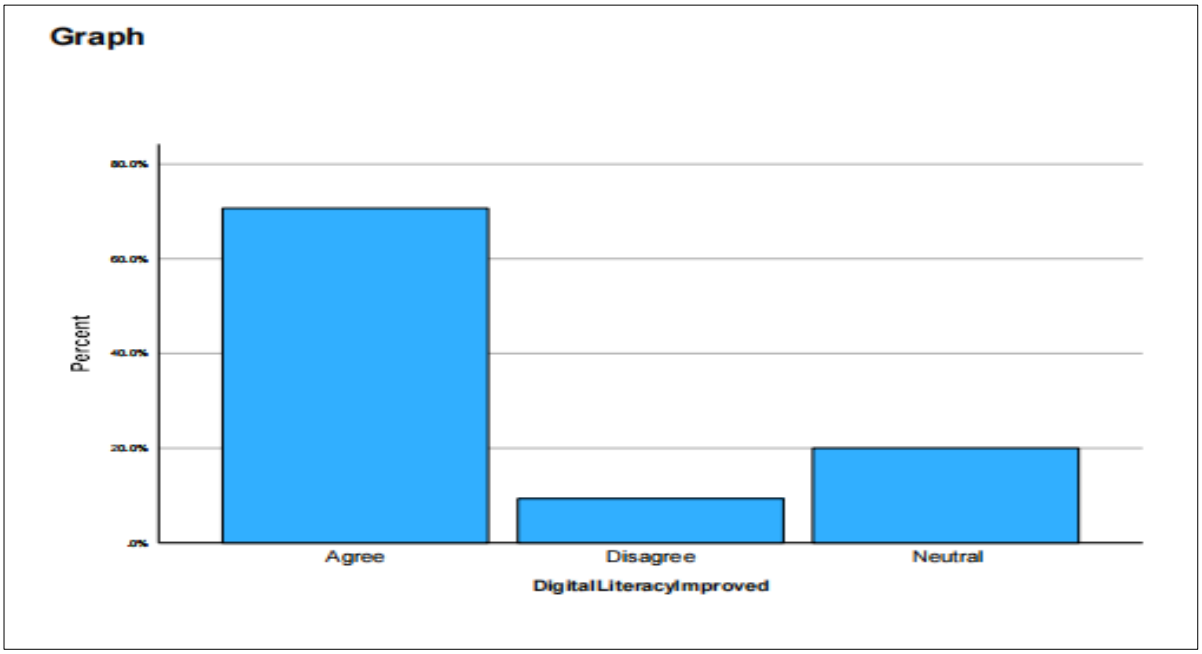
*Improvement in Critical Thinking Skills through AI Usage*




*Source. Research Findings, 2026.*

**Figure 3**

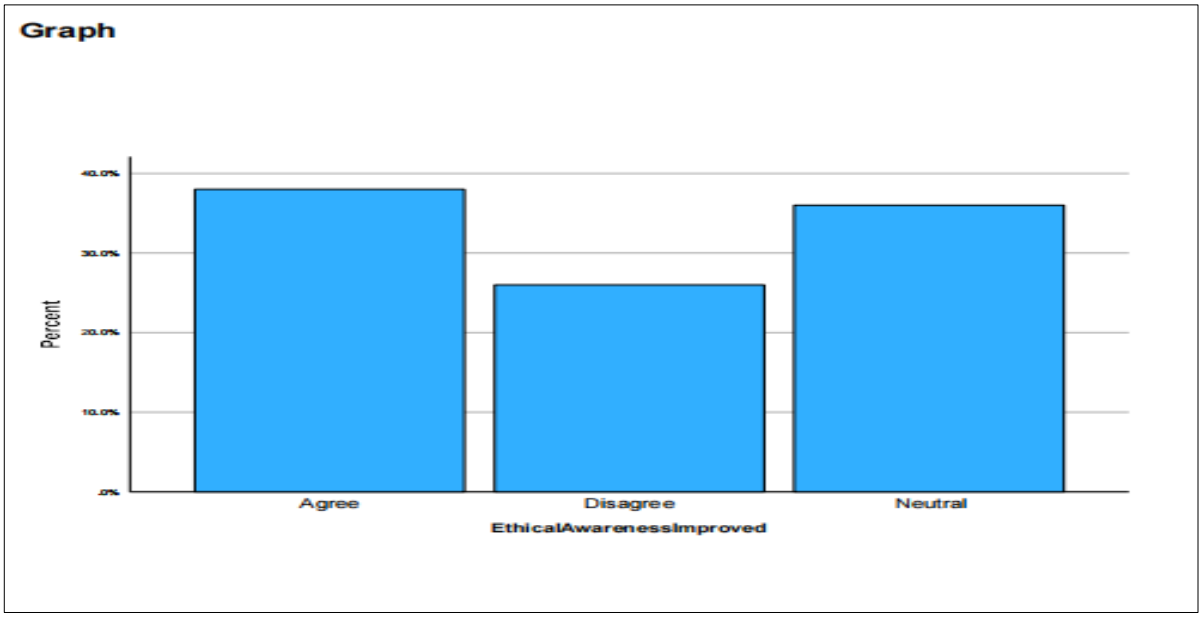
*Improvement in Digital Literacy Skills*




*Source.* Research Findings, 2026.

**Figure 4**

*Improvement in Ethical Awareness*




*Source.* Research Findings, 2026.

The strongest gains were observed in digital literacy, where more than 70% of respondents agreed that AI enhanced their ability to navigate digital platforms, interpret online information, and integrate AI-generated outputs into academic tasks. These findings support earlier studies suggesting that exposure

to AI technologies accelerates students' acquisition of digital competencies (Selwyn, 2021). However, improvements in critical thinking (45.3%) and ethical awareness (38%) remained comparatively limited. Correlation analysis further revealed that digital literacy had the strongest relationship with AI adoption ($r = 0.701$, $p < 0.001$), while ethical awareness showed a weaker but still significant relationship ($r = 0.421$, $p < 0.01$). These findings suggest that AI adoption is more effective in enhancing technical and operational competencies than deeper reflective or ethical capacities. Interview data supported this interpretation. Lecturers noted that many students copied AI-generated responses directly into assignments without critically evaluating the accuracy of the content, the reliability of sources, or the presence of algorithmic bias. Several students admitted that although AI made learning faster and easier, it sometimes reduced their motivation to think independently. This pattern reflects what Dwivedi et al. (2023) describe as "automation bias," where users become overly dependent on machine-generated outputs. Regression analysis also indicated that student competencies significantly influenced professional readiness ($\beta = 0.49$, $t = 6.32$, $p < 0.001$). This demonstrates that competency development acts as an important mediating factor between AI adoption and future career preparedness. Students who demonstrated stronger digital literacy, ethical reasoning, and critical thinking were more likely to express confidence in their future employment and in AI-integrated professional environments.

## Professional Readiness: Urban Planning and Smart Cities

The third dimension examined how AI adoption and competencies translated into professional readiness, particularly in urban planning and smart city governance contexts.

**Table 6**

*Student Perceptions of Professional Readiness*

| Readiness Aspect | Confident (%) | Unsure (%) | Not Confident (%) |
|---|---|---|---|
| General employ-ability with AI | 58.0 | 30.7 | 11.3 |
| Readiness for urban planning/smart cities | 40.0 | 45.3 | 14.7 |
| Ability to balance ethics/AI use | 35.3 | 38.0 | 26.7 |

Most respondents (58%) believed that AI-related skills improved their general employability. This finding aligns with labor market reports that emphasize the growing importance of AI literacy and digital competencies in future employment sectors (World Economic Forum, 2023). Nevertheless, only 40% felt confident applying AI specifically within urban planning and smart city contexts, while nearly half remained uncertain. The regression findings further showed that AI adoption and student competencies jointly contributed significantly to professional readiness ($F = 52.41$, $p < 0.001$). The combined predictors explained a substantial proportion of variance in readiness levels, indicating that professional preparedness is influenced not only by exposure to AI technologies but also by the quality of competencies developed through that exposure. More concerningly, only 35.3% of respondents expressed confidence in balancing ethical considerations with AI usage. Interview findings revealed that students were more familiar with technical AI applications, such as simulation tools and spatial analysis software, than with discussions of privacy, fairness, inclusivity, and algorithmic accountability. Lecturers similarly acknowledged that existing curricula prioritize technical performance over ethical and societal implications.

This study demonstrates that AI adoption in higher education enhances productivity, efficiency, and self-directed learning, particularly in academic tasks such as information retrieval and assignment preparation. However, its contribution to professional readiness is not automatic and depends on the development of key competencies such as critical thinking, digital literacy, ethical reasoning, and discipline-specific knowledge. Without structured guidance, students risk over-reliance on AI tools, which may limit deeper learning, creativity, and reflective judgment. Therefore, AI adoption must be supported by pedagogical strategies that strengthen higher-order thinking skills rather than focusing solely on technical usage.

In terms of professional readiness, particularly in urban planning and smart-city contexts, the findings reveal a clear gap between general AI use and discipline-specific applications. While students are familiar with generative AI for academic purposes, they show limited understanding of its professional use in areas such as GIS, spatial modeling, environmental monitoring, and urban governance systems. This indicates that general AI literacy alone is insufficient for preparing students for future professional demands. As such, curriculum reform is needed to integrate AI tools directly into discipline-based learning, ensuring graduates are equipped to apply AI to real-world problem-solving. The study also highlights significant ethical concerns, including uncertainty about academic integrity, authorship, and responsible AI use. Despite being digital natives, Generation Z students demonstrate limited awareness of issues such as algorithmic bias and data privacy, raising concerns for their future professional practice. To address this, universities must strengthen ethical education, establish clear AI governance policies, and provide interdisciplinary and educator training support. These measures are essential to ensure that AI adoption leads not only to technological competence but also to responsible, critical, and professionally ready graduates. By embedding these reforms, higher education can transform AI adoption from a superficial engagement with tools into a catalyst for holistic professional readiness. For urban planning education, this means cultivating graduates who can critically leverage AI tools to design sustainable, inclusive, and resilient cities. More broadly, the integration of policy, curriculum, and competency-based approaches ensures that Generation Z students transition from being passive adopters of AI to active shapers of technological futures in their respective fields.

## CONCLUSION

Artificial Intelligence (AI) has become an integral component of contemporary higher education, significantly influencing how students learn, engage with academic tasks, and prepare for future professional roles. This study, conducted at Universiti Utara Malaysia (UUM), reveals that Generation Z students exhibit a generally positive attitude toward AI adoption, primarily using it as a tool for efficiency, productivity, and academic support. However, the empirical findings indicate that AI adoption alone does not automatically translate into professional readiness, as its effectiveness is strongly dependent on the development of student competencies, particularly in critical thinking, ethical reasoning, and discipline-specific knowledge. The main empirical contribution of this study is to demonstrate that student competencies serve as a critical mediating factor between AI adoption and professional readiness. While AI tools enhance learning efficiency and task completion, they do not inherently develop higher-order skills required in professional fields such as urban planning and smart city development. Instead, the data show a consistent gap between frequent AI usage and students' ability to apply AI meaningfully in complex, real-world professional contexts. This highlights that technological adoption must be accompanied by structured competency development to ensure meaningful educational outcomes.

Furthermore, the study provides evidence that discipline-specific exposure to AI remains limited, despite general familiarity with generative tools. In fields such as urban planning, students demonstrate insufficient understanding of how AI supports spatial analysis, urban simulation, and sustainability planning. This reinforces the need for curriculum transformation that embeds AI within professional practice rather than treating it as a generic academic tool. Ethical considerations also emerge as a key finding, with students showing uncertainty regarding appropriate AI use, originality, and academic integrity. This suggests that ethical literacy is not yet sufficiently integrated into current AI-related learning environments, posing risks to future professional practice as algorithmic decision-making becomes increasingly prevalent. Overall, the findings emphasize that AI should be understood as an enabling tool rather than a substitute for human competencies, and its educational value is maximized only when integrated with strong pedagogical and ethical frameworks.

Institutional Policy Frameworks: Universities must establish clear, principle-based AI governance policies that balance innovation with academic integrity. These frameworks should address appropriate use, plagiarism risks, data privacy, and transparency while remaining flexible enough to accommodate disciplinary differences. Curriculum Reform and AI Literacy. AI literacy should be embedded as a core graduate competency across disciplines, integrating: Technical literacy (discipline-specific AI tools such as GIS and predictive modeling); Critical and ethical literacy (bias detection, evaluation of AI outputs, and fairness and sustainability considerations); and Professional literacy (application of AI in real-world decision-making contexts). For professional programs such as urban planning, AI should be embedded in project-based learning, simulations, and applied studios, ensuring alignment with industry practices. Capacity-Building for Educators and Students. Sustainable AI integration requires continuous professional development for educators and structured learning environments for students. Interdisciplinary initiatives and industry collaboration should be expanded to support reflective and responsible AI engagement. Implications for Future Research. This study contributes to the literature by highlighting the mediating role of competencies in AI adoption outcomes. Future research should focus on comparative studies across disciplines to assess variations in AI readiness; longitudinal studies on the long-term impact of AI-integrated curricula; and policy-focused research on harmonizing AI governance in higher education institutions. In conclusion, this study demonstrates that the value of AI in higher education extends beyond technological adoption. Its true impact depends on integrating competency development, ethical awareness, and curriculum alignment with professional practice. By strengthening these dimensions, universities can ensure that graduates are not only proficient AI users but also critically reflective, ethically responsible, and professionally competent individuals capable of contributing to complex fields such as urban planning and sustainable development.

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