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Advanced digital literacy: Analysis of student readiness in facing generative AI

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ABSTRACT

The development of artificial intelligence technology, particularly generative artificial intelligence (generative AI), has brought about significant changes, especially in higher education. This condition requires students not only to understand the use of basic digital tools but also to master advanced digital literacy, which includes evaluative, strategic, and adaptive abilities in response to technological automation. This study aims to explore students' readiness to master advanced digital literacy and identify the factors influencing it. This study employed a qualitative approach, with data collected through in-depth interviews, observations, and document analysis involving students in the Civic Education Study Program at Halu Oleo University. The findings show that students demonstrate high readiness to utilize AI for academic needs and technological adaptation. However, this readiness is not balanced with adequate information validation abilities, understanding AI mechanisms, and awareness of digital ethics. These findings align with advanced digital literacy theories that emphasize the evaluative, ethical, and critical aspects of modern technology use. The tables included in this study reinforce the pattern that students' readiness tends to be stronger in operational aspects but weaker in reflective and evaluative ones. This study contributes to the development of a more adaptive advanced digital literacy learning model in higher education for the generative AI ecosystem.

Keywords: advanced digital literacy; generative AI; students; digital competence; technology readiness.

1. INTRODUCTION

Technological advancements in the era of Industrial Revolution 4.0 have brought significant changes in various aspects of life, including education. One of the most rapidly developing technologies receiving major attention is artificial intelligence. The rapid transformation of digital technology has reshaped the landscape of modern education, particularly in Indonesia. Artificial intelligence now offers innovative solutions for improving learning quality, such as personalized learning, data analysis, and automated content management. The emergence of AI models such as ChatGPT, Claude, Gemini, and similar systems signals a major technological shift, opening new opportunities and challenges for educators and students. The use of generative AI in Indonesian higher education is increasing. Students utilize these tools for text generation, data analysis, visual design, and other academic activities. As a result, students are required to master not only basic digital skills but also advanced digital literacy, including critical thinking, evaluative skills, and ethical awareness in using AI. Advanced digital literacy is a strategic competency for addressing this issue. Belshaw (2012) states that digital literacy includes several elements, such as cognitive, constructive, and communicative competencies. Meanwhile, the Digital Competence Framework 2.2 (DigComp), developed by Carretero et al. (2022), explains five main domains of advanced digital literacy: information literacy, digital communication, content creation, digital safety, and problem-solving.

Furthermore, the AI Literacy Framework by Long and Magerko (2020) emphasizes that users must understand how AI works, be able to assess risks and algorithmic bias, and critically interpret AI output. These theoretical foundations assert that advanced digital literacy is not merely a technical ability but also involves evaluative and ethical dimensions. Digital literacy is the ability to use various digital media to find, share, and create information. It is also a means to enhance the skills needed to understand and use unlimited information accessible anywhere and at any time via the Internet. Students are now required to understand modern forms of literacy, such as information, media, and ICT literacy. However, students' readiness to adopt new technologies is not influenced solely by digital competence. Parasuraman and Colby's (2015) Technology Readiness Index shows that technological readiness is influenced by optimism, innovativeness, discomfort, and insecurity. External factors such as institutional support, prior technological experience, perceived ease of use, and perceived usefulness also play an important role, as explained by the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003).

Several previous studies have shown that students have high enthusiasm for using AI but still face challenges in digital ethics, information evaluation, and reflective abilities (Sakib et al., 2025). A study involving 2,555 students at the University of Liverpool found that, although awareness of generative AI is high, only a small proportion can use it effectively for academic purposes (Hughes et al., 2024). Other research has also shown that technological readiness depends not only on access to devices but also on the user's capability to adapt to technological change. In higher education, students' ability to use AI is influenced by the learning environment, including university-provided training (Islam et al., 2025). Based on these research gaps, this study aims to explore students' readiness to face the generative AI ecosystem and identify factors influencing that readiness based on students' experience, perception, and challenges. This study is expected to contribute to the development of advanced digital literacy curricula, improvement of AI policies in higher education, and strengthening of students' ability to use AI critically and ethically.

2. RESEARCH METHOD

This study employed a descriptive qualitative design with a phenomenological approach to explore students experiences and interpretations of using generative AI in academic contexts. Phenomenology was chosen because it enables the researcher to capture the meaning-making process behind students' interactions with AI—how they decide to use it, trust it, and evaluate its academic and ethical implications. The study focused on lived experiences related to advanced digital literacy, conceptually mapped using

DigComp 2.2, the AI Literacy Framework, and technology readiness perspectives (TRI/UTAUT) as sensitizing frameworks for interpretation rather than as measurement instruments. The research was conducted at Halu Oleo University, specifically in the Civic Education Study Program. This context was selected because students in this program frequently engage in reading, argumentation, policy interpretation, and academic writing—activities in which generative AI tools are commonly used for summarizing, drafting, and conceptual clarification. The setting also represents a relevant higher education context in Indonesia, where AI adoption is growing rapidly, while formal institutional guidance may still be limited. Participants were selected using purposive sampling to ensure that the informants had direct experience using generative AI (e.g., ChatGPT, Gemini, Claude) for academic tasks. The inclusion criteria were as follows:

1. active students in the Civic Education Study programme;
2. have used generative AI for academic purposes within the last semester (e.g., writing, summarizing, searching for concepts, preparing presentations);
3. willing to participate in interviews and allow classroom/learning observations, when applicable.

To strengthen the variation in experiences, the sample considered diversity in terms of semester level, frequency of AI use, and types of tasks performed using AI. Recruitment continued until information saturation was reached (i.e., no new themes emerged across interviews). Data analysis followed Miles and Huberman (1984) interactive model, consisting of interview recordings that were transcribed and key statements coded. The initial coding focused on experiences and practices related to AI use, evaluation, ethics, and adaptation to AI. The codes were organized into thematic matrices and domain mapping tables (e.g., alignment with DigComp 2.2 domains: information literacy, communication, content creation, safety, and problem solving). Conclusion drawing and verification: Themes were refined through constant comparisons of interviews, observations, and documents. Verification included checking theme consistency, seeking negative cases (contradictory experiences), and confirming that the interpretations were supported by evidence. The thematic structure was then synthesized into broader readiness patterns (e.g., "high AI use—low validation skills") and interpreted using the selected frameworks (DigComp 2.2, AI Literacy Framework, TRI/UTAUT).

3. RESULT AND DISCUSSION

3.1. General Findings

The research revealed that students showed positive attitudes and enthusiasm toward generative AI tools such as ChatGPT and Gemini. These tools are considered helpful for finding references, initiating writing, understanding complex concepts and completing academic assignments. However, field findings show that not all students can evaluate the accuracy, quality, and potential bias of AI-generated outputs. An excerpt from an interview reveals the following:

> *"After using AI and receiving an answer that matches my command, sometimes I trust it immediately without checking its accuracy. After my friend informed me, I checked again and found that the result was not entirely correct."*
> *(Interview, November 26, 2025).*

This indicates a gap between AI use and students' critical evaluation skills, similar to the findings of Hughes et al. (2024) and Sakib et al. (2025). Although students show high enthusiasm, their digital literacy remains basic. They lack advanced digital literacy characteristics, such as critical thinking, information validation, and ethical awareness.

Table 1. Students' General Perception of Generative AI

No.	Aspect	Findings	Readiness Level
1	AI use	High	Ready
2	Information & validation	Low	Not ready
3	Understanding AI mechanisms	Moderate	Needs reinforcement
4	Digital ethics	Low	Not ready
5	Technological adaptation	High	Ready

Based on the findings presented in Table 1, the results provide a general overview of students' use of generative AI in academic contexts. The study indicates that students exhibit varying levels of readiness across the five main aspects analyzed in this study. In terms of utilizing AI for academic purposes, the findings show that students hold a very positive perception, falling into the high category. This suggests that, in general, students are already prepared to use generative AI technology to support their coursework, writing tasks, and academic problem-solving. In contrast, students demonstrate low ability in terms of information validation and evaluation (Bawden & Robinson, 2022). This indicates that they are not yet ready to verify AI-generated outputs; instead, they tend to accept AI-generated information at face value without further verification. As a result, this increases the potential risks such as plagiarism, misinformation, and logical inaccuracies. In the third aspect, understanding how AI systems work, the results show that this aspect falls into the low category. This suggests that while students possess basic knowledge, they still require reinforcement of their AI literacy. Most students have not yet fully mastered the technical understanding of how AI produces responses, including its limitations, models, potential biases, and algorithmic principles.

In terms of digital ethics awareness, the findings also indicate a low level of competence, categorizing students as unprepared. This shows that students have not yet fully understood the ethical implications of AI use, such as academic integrity, data privacy and responsible use. This highlights the importance of increased attention from educators and institutions. Finally, in terms of technological adaptation, students again demonstrated high ability and were categorized as ready. They reported no difficulty in using various generative AI platforms and applications, indicating strong technological adaptability. Table 1 illustrates that students are technically ready to use generative AI but remain weak in cognitive and ethical aspects, particularly in information evaluation skills and digital ethics awareness. These findings indicate that educational interventions, especially in AI literacy and digital ethics, are urgently needed to ensure the responsible use of AI in academic environments.

3.2. Student Readiness Viewed Through the Lens of Digital Literacy Frameworks

Belshaw's (2012) theory explains that digital literacy consists of eight elements, including cognitive, criticality, constructive, and confidence. Based on the findings of this study, it was shown that in the constructive domain, student participation is relatively strong, particularly in utilizing AI to generate ideas, summaries, and initial understanding of a topic. The interview results with several informants revealed that AI helped them develop research topics that they previously found difficult to formulate. However, regarding criticality and cognitive skills, the findings indicate that students' understanding remains weak. Many students accept AI-generated outputs without conducting additional verification, which increases the risk of unintentional plagiarism and misinformation and a decline in higher-order thinking skills. These findings reinforce Belshaw's argument that advanced digital literacy does not merely involve technological proficiency but also the ability to critically assess and evaluate information quality.

3.3. Analysis of Findings Based on DigComp 2.2

One of the most recent efforts to integrate data literacy into the digital competence framework is reflected in the updates to DigComp 2.2. DigComp is the most widely used digital competence framework, both internationally and nationally. It aims to help citizens use digital technology confidently and safely, including AI technologies. Referring to the Digital Competence Framework 2.2 (Carretero et al., 2022), students' digital competence varies across several domains, namely:

a. Information literacy domain: Students are fairly capable of searching for and locating information; however, they are not yet accustomed to systematically evaluating information quality. Many have reported difficulty in distinguishing between accurate information and inaccurate AI-generated content, a phenomenon known as *AI hallucination*.

b. Information literacy domain: Students are fairly capable of searching for and locating information; however, they are not yet accustomed to systematically evaluating information quality. Many have reported difficulty in distinguishing between accurate information and inaccurate AI-generated content, a phenomenon known as *AI hallucination*.

c. Digital communication and collaboration domain: Some students used AI to compose academic messages, but they did not yet fully understand the ethics of digital communication, including message formality and clarity of the sources used.

d. Digital content creation domain: Most students merely modify AI-generated content and have not yet reached the stage of producing original content that meets academic standards.

e. Digital safety domain: Most students lack an understanding of data privacy issues, security vulnerabilities, and risks associated with the misuse of AI technologies.

f. Problem-solving domain: Students tended to rely on AI to solve problems but were unable to determine when AI should be used appropriately and when its use should be avoided.

Based on these findings, students' digital competence can be categorized as moderate; therefore, more structured educational interventions are needed to help them achieve advanced digital competencies (see Table 2).

Table 2. Mapping of Students' Digital Competence Based on DigComp 2.2

No.	DigComp 2.2 Domain	Students' Competence Level	Description
1	Information literacy	Moderate	Needs stronger evaluation skills
2	Digital communication	Moderate	Limited understanding of ethics
3	Content creation	Low–moderate	Mostly modifies AI-generated content
4	Digital safety	Low	Minimal awareness of privacy issues
5	Problem-solving	Low	Unable to assess AI limitations

3.4. Analysis of Findings Using the AI Literacy Framework

The AI Literacy Framework proposed by Long and Magerko (2020) emphasizes four key competencies: understanding AI, the ability to identify bias, evaluating AI outputs, and critical use. The findings of this study show that students tend to perceive AI as a tool that provides answers rather than as a complex system with underlying algorithms and inherent biases. The interview results further revealed that several informants were unaware that AI could sometimes generate false references or invalid theories. This indicates a weak understanding of the critical evaluation aspect, which is an essential component of

AI literacy. These findings are consistent with the conclusion that students' AI literacy remains functional—focused on its utility—rather than conceptual, which requires understanding the mechanisms and principles that underlie AI systems.

3.5. Readiness Factors Based on the Technology Readiness Index (TRI)

According to the TRI model (Parasuraman & Colby, 2015), technological readiness is influenced by four dimensions: optimism, innovativeness, discomfort, and insecurity.

a) The findings show that students exhibited a relatively high level of optimism regarding the use of generative AI. They perceive AI as helpful in supporting the learning process, accelerating task completion, and improving their academic efficiency. This optimism and innovativeness strengthen their overall readiness to engage with technological advances.

b) Field findings reveal that some students feel anxious about the originality of their academic work when using AI, the possibility of being flagged for plagiarism, and institutional restrictions on AI use for specific assignments. Such uncertainty can reduce students' readiness, even if they are strongly willing to explore new technologies. These findings align with Islam et al. (2025) study, which indicates that insecurity is a main barrier to AI adoption among students.

3.6. Learning Environment Factors Based on UTAUT

Referring to the UTAUT model (Venkatesh et al., 2003), students' readiness to use generative AI was influenced by four components: performance expectancy, effort expectancy, social influence, and facilitating conditions.

a) Performance expectancy: The findings indicate that students believe AI can enhance their academic performance, particularly in searching for theories, summarizing readings, and supporting academic writing.

b) Effort expectancy: The study shows that most students find AI easy to use, even without advanced technical skills.

c) Social influence: The use of AI is driven by classroom trends, peer encouragement, and the need to keep up with academic developments.

d) Facilitating conditions: The findings revealed that institutional support remained limited. Students reported that they had never received formal training in AI usage, reference validation, or digital safety. This lack of support is the strongest barrier to increasing their readiness.

3.7. Synthesis of Findings and Theoretical Integration

The integration of Belshaw's theory, DigComp, the AI Literacy Framework, TRI, and UTAUT demonstrates that students' readiness to face the generative AI ecosystem is multi-dimensional. Readiness is not determined solely by technical abilities; it also involves conceptual understanding, ethical awareness, attitudes toward technology, and support from the academic environment. Thus, this discussion reinforces the need for advanced digital literacy to become a central focus of learning in higher education, particularly in response to the increasing use of generative AI in academic contexts.

4. CONCLUSION

Based on the research findings and discussion that integrate various theoretical frameworks, it can be concluded that students' readiness to utilize generative AI technology falls into the moderate category, with the following patterns: high utilization of AI but low evaluative ability**.** Students show strong

enthusiasm for using AI to understand theories, begin writing assignments, compile references, and solve academic problems. However, this enthusiasm is not accompanied by adequate critical skills for validating information, which leads to the risk of misinformation, unintentional plagiarism, and epistemic bias. Students' digital literacy remains at a basic–intermediate level. The findings indicate that students are strong in the constructive element (Belshaw), yet weak in criticality, cognitive skills, and confidence when assessing AI outputs. Within the DigComp 2.2 framework, students showed strengths in basic information literacy and technological adaptation but consistent weaknesses in digital safety, communication ethics, and creative content production. Students' AI literacy is more functional than it is conceptual**.** Students tend to view AI as an "answer machine" rather than a system with underlying algorithms, biases, and structural limitations. This demonstrates low competence in bias evaluation and understanding how AI systems work, as emphasized in the AI Literacy Framework.

Technological readiness is shaped by the duality of optimism and anxiety. According to the TRI, students exhibit high optimism and innovativeness but still experience anxiety related to academic originality, plagiarism detection, and institutional rules on AI use. These factors decrease the consistency of their preparedness. Institutional factors are the main determinants. Based on the UTAUT, institutional support in terms of policies and training is very limited, resulting in students learning to use AI independently. Facilitating conditions have a moderate to strong influence on readiness and technology adoption behaviors.

Ethical Approval

Not Applicable

Informed Consent Statement

Not Applicable

Authors' Contributions

Indrawati Syamsuddin led the study by developing the research concept and design, selecting the methodological approach, coordinating data collection, and taking primary responsibility for drafting the manuscript and supervising the overall research process. Verawati contributed mainly to the empirical component by supporting participant recruitment and field access, assisting with data collection and documentation, organizing and validating the data, and providing substantive feedback during manuscript revision. Ilhamurrahman M. Hubaib supported the analytical phase by conducting and refining the qualitative analysis, managing data coding and organization, preparing thematic summaries and visual/tabular outputs, and contributing to writing and revising the manuscript to strengthen the interpretation and presentation of findings.

Disclosure Statement

The Authors declare that they have no conflict of interest

Data Availability Statement

The data presented in this study are available upon request from the corresponding author.

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Notes on Contributors

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Indrawati Syamsuddin is a lecturer at Universitas Halu Oleo (Kendari, Indonesia). Her scholarly profile indicates active work in education-related areas, with publications indexed in academic platforms and a verified institutional affiliation.

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Verawati is affiliated with Institut Teknologi dan Bisnis Bina Adinata (Bulukumba, South Sulawesi, Indonesia), an institution that hosts and manages multiple academic journals through its research unit (LPPM). Her role in the study aligns with field-based academic activities and institutional engagement.

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