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AI literacy and digital competence among university students: Evidence from Vietnam

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Abstract
This study investigates the intersection of AI Literacy and Digital Competence among university students in Vietnam, employing the European DigComp 2.2 framework as a theoretical foundation. Utilizing a quantitative approach with a valid sample of 412 students, the research evaluates the current state of digital readiness through reliability analysis, Exploratory Factor Analysis (EFA), and One-way ANOVA. The findings reveal a significant competence paradox: while students exhibit high technical proficiency in AI tool usage ($M = 4.15$), their scores for critical evaluation and ethical awareness remain notably lower ($M = 2.75$). The ANOVA results ($F(3, 408) = 12.425$, $p < 0.001$) indicate that AI literacy significantly improves as students progress toward their senior years, particularly during the transition into major-specific curricula, although a plateau effect is observed between the junior and senior levels. These results suggest that Vietnamese higher education must shift from teaching basic ICT skills to fostering AI-Integrated Thinking. The study provides crucial implications for educators and policymakers in Vietnam to redesign curricula that balance technical mastery with algorithmic accountability and ethical integrity, thereby ensuring a future-ready digital workforce.

Keywords: AI literacy, digital competence, digcomp 2.2, higher education, Vietnam, ANOVA

Introduction

The explosion of Generative Artificial Intelligence since late 2022 [4] has established a new era in the global higher education ecosystem, where the ability to interact between humans and machines is no longer a supplementary skill but a core survival competency. In Vietnam, one of the fastest-growing digital economies in Southeast Asia, the presence of Large Language Models such as ChatGPT, Claude, and Gemini has created profound shifts in how students access and process knowledge. According to educational technology trend reports for 2025 [12], the adoption rate of AI among Vietnamese students has reached an estimated 85 - 90%. However, this surge in usage frequency does not necessarily correlate with a deep understanding of the underlying technology. This rapid proliferation poses a significant challenge for educational administrators in redefining the concept of digital competence in the age of AI.

The theoretical landscape of digital competence has witnessed a pivotal transition from traditional office computing skills to the multidimensional DigComp 2.2 framework established by the European Union. This framework emphasizes not only technical proficiency but also data literacy, information security, and ethics within digital environments. In the Vietnamese context, although the Government has approved the National Strategy on Research, Development, and Application of Artificial Intelligence until 2030 [16], empirical evidence reveals an alarming competence gap. Preliminary studies in 2025 indicate that while 70% of students feel confident in their prompt engineering skills, fewer than 25% possess the ability to identify algorithmic bias or verify the authenticity of AI-generated data. This creates a paradox: Vietnamese students are becoming proficient users yet remain vulnerable digital consumers in the face of AI hallucinations and misinformation.

The current research gap lies in the fact that most existing studies in Vietnam still focus on technology acceptance models (TAM) or usage intentions, rather than conducting empirical measurements of actual competence based on international reference frameworks. Particularly for specialized fields such as Accounting and Finance at major institutions like the University of Finance - Marketing or the University of Economics Ho Chi Minh City, the requirement for digital data accuracy is exceptionally stringent. The reliance of students in these fields on AI for processing balance sheets or tax analysis without adequate risk management competencies could lead to serious professional repercussions in the future. Consequently, identifying influential factors such as academic major, year of study, and differences in AI ethical awareness has become an urgent task for developing appropriate pedagogical pathways.

This study aims to fill that gap by providing empirical evidence regarding the relationship between AI Literacy and Digital Competence among university students in Vietnam. By utilizing One-way ANOVA and post-hoc testing on a representative survey sample, the paper seeks to answer questions concerning competence variations across the timeline of academic training and specialization. The findings not only contribute to the theoretical expansion of the DigComp 2.2 framework in the context of developing nations but also provide practical implications for educational policymakers in Vietnam. It advocates for the integration of AI into the formal curriculum to prepare a digital workforce equipped with critical thinking skills and academic integrity.

Literature Review

The conceptualization of digital competence has transcended beyond mere technical proficiency (ICT skills) to become a multi-layered construct involving cognitive,

social, and ethical dimensions. Ferrari (2012) [5] originally defined digital competence as the set of knowledge, skills, and attitudes required to use ICT and digital media to perform tasks and solve problems. This foundation led to the development of the European Digital Competence Framework for Citizens (DigComp). The latest iteration, DigComp 2.2, released in 2022 [4], emphasizes the integration of Artificial Intelligence (AI) and data literacy as essential components (Vuorikari *et al*, 2022). Scholars such as Ala-Mutka (2011) and Calvani *et al*. (2008) [1, 2, 13] argue that in the modern educational landscape, digital competence is no longer a static skill set but a dynamic ability to adapt to emerging technologies, including algorithmic systems and automated decision-making.

As AI becomes ubiquitous in higher education, the term AI Literacy has emerged as a distinct but interconnected subset of digital competence. Long and Magerko (2020) [8] proposed a foundational framework for AI literacy, defining it as a set of competencies that enable individuals to critically evaluate AI technologies, communicate and collaborate with AI, and use AI as a tool for online problem-solving. This framework consists of four levels: (1) Understanding what AI is; (2) Using AI tools; (3) Evaluating AI outputs; and (4) Understanding the ethical implications. Furthermore, Ng *et al*. (2021) expanded this by highlighting that AI literacy is not just about technical knowledge but also about human-AI interaction (HAI) and the ability to recognize algorithmic bias. In the academic context, Zawacki-Richter *et al*. (2019) [14] emphasize that AI literacy is crucial for maintaining academic integrity in an era where generative tools can easily mimic human-like writing.

Recent empirical studies have highlighted a global competence gap among university students. A study by Laupichler *et al*. (2022) [7] across European universities revealed that while students possess high usage self-efficacy, their conceptual understanding of AI remains significantly lower. Similarly, in the Asian context, research by Huang *et al*. (2023) [6] in China and Hong Kong found that students' AI literacy is heavily influenced by their academic major, with STEM students outperforming social science students in technical comprehension but showing similar levels of ethical uncertainty. Regarding the impact on learning outcomes, Casal-Otero *et al*. (2021) [3] demonstrated that students with higher levels of digital competence are more likely to utilize AI tools for deep learning rather than superficial task completion.

In Vietnam, the academic discourse on digital competence has gained momentum following the national digital transformation mandates. Nguyen and Le (2024) [10] observed that Vietnamese students are among the most proactive in adopting new technologies; however, their digital safety and information verification skills often lag behind international standards. Specific to the accounting and finance sectors, Pham (2025) [11] argued that the digital transformation of Vietnam's financial system requires a new generation of accountants who possess both domain expertise and digital-first analytical skills. Recent findings by Tran *et al*. (2025) [12] suggest that while institutional support at major Vietnamese universities (such as UFM or UEH) has increased, there is still a lack of a standardized curriculum for AI literacy, leading to fragmented competence development among students.

Methodology

This study employs a quantitative research design utilizing a cross-sectional survey method to collect data from university students. The methodology is designed to ensure the reliability and validity of findings within the specific context of Vietnam's higher education digital transformation.

Sampling and Participants

The study utilized a purposive and convenience sampling technique to target students from major public universities in Vietnam, with a particular focus on those specializing in Economics, Accounting, and Technology (e.g, University of Finance - Marketing, and University of Economics Ho Chi Minh City). Sample Size: A total of 450 questionnaires were distributed via digital platforms (Google Forms) and direct classroom administration. After excluding incomplete or inconsistent responses, the final valid sample consisted of N = 412. Demographics: The sample maintains a balanced distribution across different academic years (Year 1 to Year 4) and genders to facilitate comparative analyses such as ANOVA and T-tests.

Research Instrument

The survey instrument was adapted from the DigComp 2.2 framework and the AI Literacy Scale developed by Long and Magerko (2020) [8]. The questionnaire is divided into three primary sections: Demographic Profiles: Gender, major, academic year, and frequency of AI tool usage (e.g, ChatGPT, Gemini). Digital Competence Scale: 15 items covering the five domains of the DigComp 2.2 framework (Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Safety, and Problem Solving). AI Literacy Scale: 5 items focusing on algorithmic awareness, critical evaluation, and ethical considerations. All items (excluding demographics) were measured using a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Data Collection Procedure

Data collection was conducted between October 2025 and January 2026. Prior to the formal survey, a pilot study involving 30 students was carried out to ensure the clarity of the Vietnamese translation and to refine technical terminology. This preliminary step ensured that the instrument was culturally and linguistically appropriate for the target population.

Data Analysis Techniques

The collected data were cleaned and processed using SPSS version 26.0. The following statistical techniques were applied: Reliability Analysis: Cronbach's Alpha coefficients were calculated to assess internal consistency ($\alpha > 0.7$). Exploratory Factor Analysis: Conducted to verify the construct validity and to ensure that the observation items properly loaded onto their respective theoretical factors. Descriptive Statistics: Mean (M) and Standard Deviation (SD) were used to evaluate the current status of students' digital and AI competencies. One-way ANOVA: Applied to test hypotheses regarding significant differences in competence levels across different academic years and majors. Post-hoc Comparisons: The Tukey HSD test was utilized to identify specific differences between groups whenever ANOVA yielded significant results ($p < 0.05$).

Results

Reliability and Construct Validity

The measurement model was initially assessed for internal consistency and construct validity. The Cronbach's Alpha coefficients for Digital Competence (α= 0.88) and AI Literacy (α = 0.82) both exceeded the recommended threshold of 0.70, indicating high reliability. Exploratory Factor Analysis was performed using Principal Component Analysis with Varimax rotation. The results yielded five distinct factors with an Eigenvalue greater than 1.0, accounting for 68.5% of the total variance. The KMO measure was 0.86, and Bartlett's Test of Sphericity was significant ($p < 0.001$), confirming the adequacy of the data for factor analysis.

Descriptive Analysis of AI Literacy and Digital Competence

Descriptive statistics revealed that while students demonstrated a moderate-to-high level of overall AI literacy (M = 3.42, SD = 0.78), there was significant disparity among specific sub-dimensions. Technical usage proficiency scored the highest (M = 4.15), whereas critical evaluation and ethical awareness of AI scored notably lower (M = 2.75), suggesting a usage-comprehension gap.

One-way ANOVA Results by Academic Year

A One-way ANOVA was conducted to examine the variation in AI Literacy across different levels of undergraduate study. The results of the analysis of variance are presented in Table 1 below:

Table 1: ANOVA Results for AI Literacy across Academic Years

Source of Variation	Sum of Squares	df	Mean Square	F	Sig. (p)
Between Groups	24.152	3	8.051	12.425	.000*
Within Groups	264.321	408	0.648		
Total	288.473	411			

***Note:** Significant at the $p < 0.001$ level.

The ANOVA results ($F(3, 408) = 12.425$, $p < 0.001$) indicate statistically significant differences in AI Literacy levels among the four academic years. Since the null hypothesis was rejected, a post-hoc Tukey HSD test was subsequently performed to determine the specific nature of these differences between the year levels.

Post-hoc Comparisons (Tukey HSD)

Since the ANOVA results indicated significant differences, a Tukey HSD post-hoc test was conducted to perform pairwise comparisons between the academic years. The results, summarizing the mean differences and their significance levels, are presented in Table 2.

Table 2: Tukey HSD Pairwise Comparisons of AI Literacy by Academic Year

(I) Year level	(J) Year level	Mean Difference (I-J)	Std. Error
Year 4	Year 1	0.850*	0.121
	Year 2	0.620*	0.115
	Year 3	0.150	0.118
Year 3	Year 1	0.700*	0.112
	Year 2	0.470*	0.108
Year 2	Year 1	0.230	0.105

* The mean difference is significant at the 0.05 level.

As illustrated in Table 2, Senior students (Year 4) exhibited significantly higher AI Literacy scores than both Freshmen (Year 1) (Diff = 0.850, $p < .001$) and Sophomores (Year 2) (Diff = 0.620, $p < .001$). Similarly, Junior students (Year 3) performed significantly better than those in their first two years. Notably, no significant difference was observed between Year 3 and Year 4 students ($p = .452$), nor between Year 1 and Year 2 students ($p = .132$), suggesting that the most substantial development in AI literacy occurs during the transition into the major-specific curriculum in the third year.

Discussion

The research findings indicate a distinct variation in AI literacy and digital competence among students throughout their academic progression. The ANOVA analysis confirms that the third year serves as a critical inflection point, where AI literacy scores surge significantly compared to the first two years. This shift can be attributed to the transition into major-specific curricula at institutions like UFM or UEH, where students begin engaging with specialized modules requiring advanced data processing and financial analysis.

These findings align with the study by Huang *et al*. (2023) [6], which asserts that the academic context and disciplinary pressures play a decisive role in motivating students to adopt emerging technological tools. However, the plateau in scores between Year 3 and Year 4 ($p = .452$) suggests that students may have reached a technical comfort zone, achieving high proficiency in tool usage (M = 4.15) without a corresponding advancement in higher-order critical thinking.

Notably, the competence gap between technical mastery and ethical awareness (M = 2.75) mirrors the concerns raised by Laupichler *et al*. (2022) [7] regarding the disparity between usage self-efficacy and conceptual understanding. Vietnamese students are evolving into proficient users yet remain vulnerable digital consumers when faced with AI hallucinations or algorithmic biases. This necessitates a more profound integration of algorithmic accountability and digital responsibility into the DigComp 2.2 framework within the Vietnamese educational context to ensure a future-ready workforce that is both technically skilled and critically grounded.

Conclusion and Recommendations

Conclusion

This study provides critical empirical evidence regarding the intersection of AI Literacy and Digital Competence among university students within the context of digital transformation in Vietnamese higher education. The key findings are summarized as follows:

The Existence of a Competence Paradox: Students exhibit high levels of confidence and technical proficiency in using AI tools such as ChatGPT and Gemini (M = 4.15). However, there is a significant deficiency in high-order skills, specifically in critical evaluation, identifying

algorithmic bias, and maintaining academic and ethical integrity (M = 2.75).

A Critical Inflection Point in Academic Progression: The ANOVA results confirm a statistically significant difference in AI literacy across academic years ($F = 12.425$, $p < .001$). Notably, the transition from the second to the third yearcoinciding with the introduction of major-specific curriculais the period of most intensive growth in digital competence.

The Senior Year Plateau: No significant difference in AI comprehension was observed between junior (Year 3) and senior (Year 4) students ($p = .452$). This suggests that students tend to reach a technical ceiling where their usage skills stabilize, yet their strategic and critical thinking does not continue to advance at the same rate.

Professional Risks in Specialized Fields: Students in Economics and Accounting at institutions such as UFM and UEH increasingly rely on AI for complex data processing. However, a lack of associated risk management skills may lead to severe professional errors in future real-world applications.

Recommendations

Firstly, higher education institutions and policymakers should standardize digital competence by fully integrating the European DigComp 2.2 framework into core curricula, moving beyond basic ICT training to foster AI-Integrated Thinking. Given the significant competence gap identified, AI literacy modules should be introduced as a mandatory requirement as early as the freshman year to prevent students from becoming passive or vulnerable users. This institutional shift is crucial for bridging the disparity between technical proficiency and critical evaluation observed among students.

Secondly, faculty members and educators need to transition their pedagogical focus from mere tool adoption to emphasizing algorithmic accountability and ethical integrity. Since students currently exhibit a plateau effect in AI literacy during their senior years, instructors should implement project-based learning and advanced human-AI interaction tasks that challenge students to critically evaluate AI outputs for bias and hallucinations. This approach is particularly vital for specialized fields such as Accounting and Finance at institutions like UFM and UEH, where data accuracy and risk management are paramount.

Finally, students must proactively shift their mindset from using generative AI as a shortcut for task completion to utilizing it as a collaborative partner for deep learning and professional problem-solving. Developing self-regulatory skills for fact-checking and maintaining academic integrity should be a priority to mitigate the Dunning-Kruger effect often associated with high-frequency AI usage. By fostering a culture of continuous learning and algorithmic awareness, students can ensure their readiness for a digital workforce that demands both technical mastery and responsible critical thinking.

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