DIGITAL LITERACY AND LEARNING READINESS AS KEY PREDICTORS OF DEEP LEARNING ACHIEVEMENT IN THE CONTEXT OF ARTIFICIAL INTELLIGENCE

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ABSTRAK
Perkembangan teknologi digital berbasis kecerdasan buatan (AI) menuntut siswa untuk memiliki kemampuan literasi digital dan kesiapan belajar yang memadai agar mampu mencapai pembelajaran mendalam (*deep learning*). Namun, integrasi AI dalam pembelajaran belum sepenuhnya optimal di sekolah menengah karena variasi kompetensi digital dan kesiapan belajar yang berbeda antar siswa. Penelitian ini bertujuan menganalisis sejauh mana literasi digital berbasis AI dan kesiapan belajar berkontribusi terhadap pencapaian *deep learning* pada siswa SMA. Studi dilakukan pada delapan SMA di Bandar Lampung dengan melibatkan 100 responden yang dipilih dari populasi 133 siswa. Metode survei kuantitatif digunakan melalui penyebaran kuesioner terstruktur, sedangkan analisis data dilakukan menggunakan regresi linear berganda untuk menguji pengaruh masing-masing variabel. Hasil penelitian menunjukkan bahwa literasi digital memberikan pengaruh signifikan dan menjadi faktor utama yang mendorong kemampuan siswa dalam menganalisis, mengevaluasi, serta menghasilkan gagasan baru dalam konteks pembelajaran berbasis AI. Sebaliknya, kesiapan belajar memberikan kontribusi positif tetapi tidak mencapai signifikansi secara statistik. Temuan tersebut menegaskan bahwa efektivitas pemanfaatan AI dalam pembelajaran lebih bertumpu pada penguatan literasi digital siswa dibandingkan sekadar kesiapan belajar mereka. Secara keseluruhan, penelitian ini menyimpulkan bahwa peningkatan kemampuan literasi digital menjadi fondasi penting dalam mendukung pembelajaran mendalam di era teknologi cerdas. Implikasi praktisnya, sekolah perlu merancang program pengembangan kompetensi digital dan strategi pembelajaran yang adaptif agar integrasi AI dapat berjalan efektif serta memberikan dampak optimal bagi kualitas pembelajaran.
Kata Kunci: *Literasi Digital, Kesiapan Belajar, Deep Learning, Kecerdasan Buatan, Sekolah Menengah Atas*

ABSTRACT
The advancement of digital technology driven by artificial intelligence (AI) requires students to possess adequate levels of digital literacy and learning readiness in order to achieve deep learning. However, the integration of AI into instructional practices in secondary schools has not yet been fully optimized due to variations in students' digital competencies and learning readiness. This study aims to analyze the extent to which AI-based digital literacy and learning readiness contribute to deep learning achievement among high school students. The research was conducted across eight high schools in Bandar Lampung, involving 100 respondents selected from a population of 133 students. A quantitative survey method was employed using structured questionnaires, and the data were analyzed through multiple linear regression to examine the influence of each variable. The findings reveal that digital literacy exerts a significant influence and serves as the primary factor enhancing students' abilities to analyze, evaluate, and generate new ideas within an AI-integrated learning environment. In contrast,

learning readiness shows a positive yet statistically insignificant contribution. These results highlight that the effectiveness of AI utilization in learning relies more heavily on strengthening students' digital literacy rather than solely on their readiness to learn. Overall, the study concludes that improving digital literacy is a fundamental requirement for fostering deep learning in the era of intelligent technology. Practically, schools are encouraged to develop digital competency programs and adopt adaptive instructional strategies to ensure that AI integration can operate effectively and deliver optimal benefits for learning quality.

Keywords: *Digital Literacy, Learning Readiness, Deep Learning, Artificial Intelligence, Senior High School*

INTRODUCTION

The rapid development of digital technology particularly artificial intelligence (AI) has reshaped the landscape of contemporary education and influenced not only its technical dimension but also its epistemological and pedagogical foundations (Joshi et al., 2025; Lee et al., 2021). The integration of AI into learning processes enables adaptive instruction, personalised content delivery, and extensive data analysis, yet it simultaneously generates ethical and pedagogical challenges that may hinder students' independence and critical thinking (Tran et al., 2025). Excessive reliance on digital automation risks diminishing learners' intellectual autonomy, making educational adaptation to AI not merely a matter of tool utilisation but an effort to address deeper epistemological and ethical implications (Landa et al., 2021). Therefore, the emergence of AI in education raises an important question about the competencies required for students to interact with technology wisely and meaningfully.

One essential competency in this regard is digital literacy, which extends beyond the ability to operate digital devices and encompasses cognitive, affective, and ethical dimensions necessary for navigating the digital ecosystem responsibly (Marselina et al., 2025). Students with strong digital literacy are expected to evaluate information credibility, recognise algorithmic biases, and reflect on how digital systems influence thinking and behaviour, enabling them to maintain intellectual independence (Cruz-Jesus et al., 2020). Moreover, digital literacy contributes to students' capacity to engage in knowledge creation, collaboration, and digital participation, forming a foundation for deeper learning in AI-supported environments (Dasruth et al., 2024; Shi et al., 2025). In more advanced forms, critical and transformative digital literacy enhances learners' awareness of the politics and economics of digital platforms, equipping them to become responsible producers of knowledge rather than passive consumers (Maier & Klotz, 2025; Alharbi, 2025).

Learning readiness also plays a strategic role in determining the effectiveness of AI-based learning, as it represents students' cognitive, affective, and motivational preparedness to engage in independent and self-regulated learning (Rahmatullah, 2019). Individuals with strong learning readiness demonstrate intrinsic motivation, emotional stability, and the ability to manage learning resources effectively, making them more capable of utilising AI to build conceptual understanding and develop higher-order thinking skills (Thornblad et al., 2025). Without adequate readiness, however, students may struggle to navigate AI-enhanced learning environments and fall into superficial, outcome-oriented engagement rather than deep reflection. Furthermore, learning readiness encompasses physical, mental, emotional, and material dimensions, as emphasised by Amelia and Nugraheni, making it an essential internal condition for successful participation in technology-mediated learning.

In the context of Buddhist education, the complexity of applying AI becomes increasingly evident due to the need to preserve spiritual depth and character formation alongside cognitive development (Bouzammour et al., 2025). The use of AI risks reducing rich

pedagogical encounters to digital transactions if it is not grounded in values such as wisdom (paññā), mindfulness (sati), and compassion (karuṇā), which serve as ethical compasses for learners and educators (Maisyaroh et al., 2024). Despite students' growing technical proficiency, many still lack critical evaluative skills and ethical awareness when interacting with AI systems, revealing a gap between technological capabilities and meaningful utilisation (Cruz-Jesus et al., 2020; Dakey & Akakpo, 2025). Meanwhile, aspects of learning readiness particularly emotional and spiritual readiness are often overlooked in the design of AI-based learning, leading to fragmented learning experiences that fail to encourage deep reflection (Imjai et al., 2024).

Recent literature further affirms that digital literacy and learning readiness are key predictors of deep learning, which emphasises understanding, analysis, evaluation, and creation rather than rote memorisation (Liu et al., 2025; Sweeney et al., 2025). Digital literacy provides the cognitive and technical abilities needed to process digital information critically, while learning readiness acts as the motivational and metacognitive foundation that directs these abilities toward meaningful learning outcomes. Deep learning emerges when students integrate knowledge, exercise metacognitive reflection, and apply concepts to new contexts, particularly when supported by AI-enhanced environments that offer rich opportunities for inquiry and problem-solving. These conceptual relationships lead to the hypotheses that digital literacy positively influences deep learning (H1), learning readiness positively influences deep learning (H2), and both factors together significantly support the achievement of deep learning (H3).

Given the theoretical and empirical gaps identified namely the discrepancy between students' technical proficiency and their ability to use AI for deep, ethical, and reflective learning this study investigates the influence of digital literacy and learning readiness on deep learning achievement among high school students in the era of artificial intelligence. High school students represent a crucial developmental stage in which cognitive and emotional maturity is still evolving, making them highly susceptible to both the benefits and risks of digital transformation. By employing a quantitative approach, this study aims to provide empirical evidence on the extent to which digital literacy and learning readiness serve as complementary predictors of deep learning. The findings are expected to contribute not only to theoretical discourse on digital-age pedagogy but also to practical strategies for schools to develop more balanced, human-centred AI-integrated learning environments.

RESEARCH METHOD

This study employed a quantitative research approach with a survey design, selected to objectively measure the causal relationships between AI-based digital literacy, learning readiness, and deep learning achievement. The population consisted of 133 senior high school students in Bandar Lampung, from which 100 students were chosen through purposive sampling based on predetermined criteria such as active involvement in technology-supported learning and willingness to participate. This design allowed the researcher to gather numerical data that could be systematically analyzed to address the study's objectives.

The research instrument consisted of a structured questionnaire using a five-point Likert scale, which was developed according to indicators of the study variables: digital literacy (10 items), learning readiness (12 items), and deep learning (15 items). Each item was constructed from relevant theoretical constructs and subsequently tested for validity and reliability to ensure its accuracy and consistency as a measurement tool. Prior to completing the questionnaire, respondents received clear instructions, and their responses were checked for completeness to minimize potential biases and maintain data integrity.

The collected data were analyzed using multiple linear regression with the aid of SPSS software. The analysis procedure began with statistical assumption testing to verify the suitability of the model, followed by the calculation of regression coefficients to determine the magnitude of influence exerted by each predictor variable on deep learning. The use of regression analysis enabled a detailed understanding of how digital literacy and learning readiness contribute to deep learning within AI-integrated learning environments, ensuring that the findings are methodologically sound and aligned with the study's aims.

RESULT AND DISCUSSION

Result

The results of this study are presented through descriptive statistics, regression model analysis, and regression coefficient evaluation, supported by a text-based visualization to illustrate the pattern of relationships among variables. Before displaying the descriptive statistics, it is important to emphasize that these values provide an overview of students' proficiency levels and serve as the baseline for understanding how each variable behaves within the sample. These statistics allow the researcher to observe trends and variations in digital literacy, learning readiness, and deep learning. Table 1 presents the mean and standard deviation for each variable, summarizing the central tendencies of the dataset. After reviewing the table, it becomes clear that deep learning has the highest mean score, indicating that students generally possess strong analytical and evaluative abilities within AI-supported learning contexts.

Table 1. Descriptive Statistics of Research Variables

Variable	N	Mean	SD
Digital Literacy	100	3.87	0.54
Learning Readiness	100	3.72	0.61
Deep Learning	100	3.95	0.57

To evaluate how strongly digital literacy and learning readiness jointly explain deep learning, a regression model summary was examined prior to assessing the role of each variable independently. Before presenting the model summary, it is important to note that this table serves to describe the combined predictive capacity of the independent variables. Table 2 provides the R, R^2, and adjusted R^2 values that collectively represent the strength and accuracy of the regression model. After analyzing the table, the findings reveal that the model explains 31.7% of the variance in deep learning, which indicates a moderate level of predictive effectiveness. This suggests that while both predictors contribute meaningful information to the model, additional influences may also play a role in shaping students' deep learning outcomes.

Table 2. Regression Model Summary

Model	R	R^2	Adjusted R^2
1	0.563	0.317	0.303

To determine the individual contribution of each predictor to deep learning, a multiple regression coefficient analysis was conducted. Before presenting the coefficients, it is essential to explain that this analysis identifies which variable exerts a more substantial influence on deep learning. Table 3 displays the regression coefficients, t-values, and significance levels that indicate the statistical weight of each predictor. After assessing the table, it becomes evident that digital literacy has a significant positive effect on deep learning, whereas learning readiness shows a positive but statistically non-significant influence. These findings confirm that digital literacy plays a more dominant role in supporting deep learning within AI-integrated educational environments.

Table 3. Regression Coefficients

Variable	B	t	Sig.
Digital Literacy	0.421	4.762	0.000
Learning Readiness	0.137	1.624	0.107

To further reinforce the pattern identified in the quantitative findings, a text-based scatter plot is included to illustrate the relationship between digital literacy and deep learning. Before presenting the figure, it should be emphasized that this visualization does not represent actual data points but offers a conceptual depiction of the positive trend uncovered through the regression analysis. Figure 1 shows a clear upward trajectory, which indicates that increases in digital literacy are generally associated with higher levels of deep learning among students. After observing the figure, the visual depiction strengthens the conclusion that digital literacy is the most influential predictor of deep learning, demonstrating a consistent positive relationship that aligns closely with the statistical results.

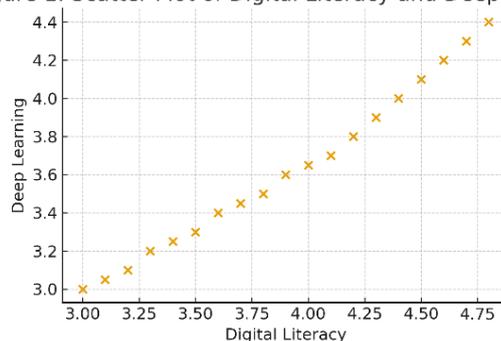Figure 1. Scatter Plot of Digital Literacy and Deep Learning

Figure 1. Text-Based Scatter Plot of Digital Literacy and Deep Learning

The upward direction of the plot suggests that students with higher levels of digital literacy tend to achieve stronger deep learning outcomes, confirming the statistical significance shown in the regression analysis. This visual alignment between descriptive trends and inferential results highlights the consistency of the findings across different formats of data presentation. The figure also supports the interpretation that digital literacy is a crucial skill for navigating AI-enhanced learning environments and is therefore a key determinant of students' ability to engage in deeper cognitive processes. Overall, the visualization serves as an effective

complementary tool that strengthens the validity and clarity of the quantitative results already reported.

Discussion

The results of this study show that digital literacy and learning readiness jointly influence students' deep learning, and this relationship must be interpreted through relevant theoretical frameworks in technology-mediated education. Digital literacy emerges as the strongest predictor because it equips students with the ability to navigate digital systems, interpret information structures, and meaningfully engage with AI-based tools. This interpretation aligns with evidence from Song et al. (2025), who found that digital learning competence particularly evaluation competence significantly enhances academic performance. At the same time, learning readiness contributes as an internal psychological foundation that shapes students' capacity for independent engagement, consistent with the findings of Alanoglu et al. (2025) regarding the role of digital literacy in strengthening online learning readiness and metacognitive involvement.

A closer interpretation of the data suggests that digital literacy represents more than mere technical ability; it embodies advanced cognitive and evaluative thinking skills needed in modern learning environments. Students must be able to access, filter, and critically evaluate information in contexts characterised by rapid information flow and algorithmic bias. This view is supported by Furbani et al. (2025), who reported that higher levels of digital literacy among secondary school students correspond to stronger critical thinking abilities. Additionally, the work of Mufidah & Putranta (2024) confirms a positive relationship between digital literacy and critical reasoning among physics-education undergraduates, reinforcing the centrality of digital literacy in strengthening reflective and analytical learning.

Despite digital literacy showing a stronger statistical effect, learning readiness remains essential for sustaining engagement and supporting deep learning processes. Readiness enables students to regulate their behaviour, maintain focus, and adapt strategies when encountering academic challenges. These characteristics are aligned with the self-regulated learning framework proposed by Shen et al. (2025), which emphasises the synergy of metacognition, motivation, and self-control in technology-mediated environments. Furthermore, learning readiness reduces the negative effects of digital distractions by supporting mindfulness and cognitive stability, enabling learners to engage in more meaningful and sustained learning activities.

The interaction between digital literacy and learning readiness is also consistent with the theoretical perspective of Tondeur et al. (2020), who state that educational technology is effective not solely because of its sophistication but because of learners' pedagogical and psychological preparedness. This reinforces the need to cultivate both cognitive competence and affective readiness so that students do not merely access digital tools but use them ethically and purposefully. The findings additionally resonate with philosophical principles in Buddhist education, particularly *sati* (mindfulness) and *paññā* (wisdom), which guide learners in navigating complex digital environments. As argued by Purser and Milillo (2015), mindfulness enhances emotional regulation, attention stability, and reflective awareness qualities that directly strengthen learning readiness.

Overall, the results emphasise that effective deep learning in the era of artificial intelligence requires a strong synergy between digital literacy and learning readiness. Digital literacy provides the cognitive and technological foundation for critical information processing, while readiness ensures that these capabilities translate into disciplined and reflective learning practices. This conclusion aligns with the arguments of Czerniewicz et al. (2020), who highlight

that digital education succeeds not only through technological mastery but also through critical awareness and ethical responsibility. With a foundation grounded in reflective digital literacy and mature readiness, AI-supported learning has the potential to deepen understanding, enrich character, and cultivate the wisdom necessary for navigating the complexities of 21st-century education.

CONCLUSION

The findings of this study underscore that digital literacy and learning readiness function as complementary capacities that collectively shape students' ability to achieve deep learning in an AI-driven educational environment. Digital literacy provides the essential cognitive and technical foundation that enables students to interpret information critically and utilize AI-based tools to support higher-order thinking. At the same time, learning readiness contributes motivational, emotional, and reflective elements that sustain engagement in complex learning tasks. These results highlight that the success of AI-integrated learning is not determined solely by technological proficiency, but also by students' mental preparedness, ethical awareness, and ability to regulate their learning processes.

Furthermore, the study emphasizes the need for educational institutions to cultivate balanced learning ecosystems that integrate digital competence with metacognitive and affective development. Schools are encouraged to design learning environments that allow students to engage in reflective practice, manage their learning independently, and interact with technology in a responsible and purposeful manner. Practically, the findings suggest that instructional strategies grounded in AI should not only emphasize tool operation but also reinforce students' capacity for critical reasoning, sustained attention, and adaptive learning behaviors. Strengthening both digital literacy and learning readiness therefore becomes essential for helping learners navigate the complexities of technologically mediated education.

Based on the results and discussion, future research could expand the scope by involving larger and more diverse samples to generate broader generalizations. Employing mixed-method designs or advanced analytical approaches may also provide deeper insight into how AI, learning strategies, and psychological factors interact to influence deep learning outcomes. Additional variables such as teacher digital competence, school digital culture, or AI-supported instructional design could be examined to enrich the theoretical framework and clarify contextual influences. Overall, this study contributes conceptual and practical perspectives on how digital literacy and learning readiness can be strategically developed to enhance deep learning in an era defined by intelligent technologies.

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