The Effect of Implementing Artificial Intelligence-Based Interactive Learning Media on Enhancing Students' Digital Literacy and Higher-Order Thinking Skills

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Abstract - *In recent years, Artificial Intelligence (AI) has created transformative opportunities for educational systems worldwide. AI is no longer viewed merely as a theoretical concept; rather, it has been integrated into various educational applications, including adaptive learning recommendation systems, virtual tutors, learning chatbots, and AI-powered interactive learning media. In 21st-century education, two essential competencies are digital literacy and Higher-Order Thinking Skills (HOTS). Digital literacy refers to the ability to access, evaluate, utilize, and manage information effectively and ethically within digital environments. Meanwhile, HOTS encompasses students' abilities to analyze, synthesize, evaluate, solve problems, and create, representing cognitive skills that extend beyond basic memorization and comprehension. This study aims to examine the effect of implementing Artificial Intelligence (AI)-based interactive learning media on improving students' digital literacy and Higher-Order Thinking Skills (HOTS). The study employed a qualitative descriptive approach through a literature review of 40 scientific articles, which were subsequently narrowed down to 13 relevant articles published between 2020 and 2025. The findings reveal that the implementation of AI-based learning media, such as educational chatbots, Gamma App, Canva AI, QuillBot, ChatGPT, PhET Simulation virtual laboratories, and intelligent tutoring systems, has a positive impact on enhancing students' digital literacy and higher-order thinking skills. The integration of AI in learning encourages students to think critically, creatively, and adaptively in response to ongoing digital technological developments. Furthermore, the study highlights the importance of improving teachers' competencies, strengthening digital infrastructure, and developing ethical and pedagogical guidelines for the effective use of AI in educational settings.*

Keywords*: AI-Powered Educational Media; Digital Literacy; Higher-Order Thinking Skills.*

INTRODUCTION

The development of digital technology in the 21st century has brought significant changes to the field of education, including the learning process at the junior high school level, particularly at SMP Negeri 4 Tolinggula. Furthermore, the rapid advancement of Information and Communication Technology (ICT) in the era of the Industrial Revolution 4.0 has transformed educational practices in various ways. One of the most rapidly growing innovations is the use of Artificial Intelligence (AI) as an interactive learning medium. AI functions not only as a supporting tool but also as an adaptive, responsive, and personalized learning partner for students. Through the implementation of AI-based learning media, instructional processes can be designed to be more engaging, contextual, and aligned with students' individual needs and abilities.

AI plays a role not only as an instructional aid but also as a learning companion capable of providing immediate feedback, analyzing students' learning progress, and adjusting the difficulty level of materials according to individual capabilities. In science learning, particularly in physics topics, students often encounter difficulties in understanding abstract concepts such as force, pressure, energy, and

vibrations. Therefore, teachers require instructional media capable of bridging students' understanding through concrete visualization and interactive experiences. AI-based interactive learning media offer an innovative solution by providing interactive simulations, adaptive explanations, and opportunities for students to explore concepts through direct experiences.

In addition to facilitating conceptual understanding, the use of AI-based interactive media is also believed to improve students' digital literacy, defined as the ability to access, understand, evaluate, and create information using digital technology responsibly (Ng, 2012). Digital literacy has become one of the essential competencies required to address global challenges and ongoing digital transformation in education. On the other hand, AI-supported learning also has the potential to foster Higher-Order Thinking Skills (HOTS), which include the abilities to analyze, evaluate, and create (Anderson & Krathwohl, 2001). Through interactive features, students are encouraged not only to memorize concepts but also to analyze phenomena, evaluate experimental results, and develop innovative solutions to physics-related problems.

However, the reality in schools indicates that most teachers still rely on conventional learning media such as PowerPoint presentations and passive videos that provide limited opportunities for dynamic interaction. As a result, learning tends to be teacher-centered and less effective in stimulating students' critical thinking skills and digital literacy. Therefore, there is a need to develop AI-based interactive learning media capable of assisting both teachers and students in creating active, collaborative, and meaningful learning environments.

In the context of 21st-century education, two crucial competencies that students must possess are digital literacy and Higher-Order Thinking Skills (HOTS). Digital literacy involves the ability to understand, evaluate, and utilize digital information critically and ethically. Meanwhile, HOTS encompasses the abilities to analyze, evaluate, and create, which are key components of the revised Bloom's Taxonomy. Both competencies are highly relevant to the objectives of the Merdeka Curriculum, which emphasizes meaningful learning, critical thinking, and learner autonomy.

The implementation of AI-based interactive learning media is believed to provide more personalized and dynamic learning experiences. Such media are capable of delivering immediate feedback, adapting learning difficulty to students' abilities, and encouraging independent exploration and reflection. Several previous studies have shown that the use of AI in education can enhance student engagement, learning efficiency, critical thinking, and problem-solving skills. Nevertheless, variations in research findings regarding the effectiveness of AI implementation in improving digital literacy and HOTS remain evident, indicating the need for a more comprehensive literature review.

Based on this background, this study aims to systematically examine the effect of implementing Artificial Intelligence-based interactive learning media on improving students' digital literacy and Higher-Order Thinking Skills (HOTS). Through this literature review, it is expected that a deeper understanding will be obtained regarding the potential, challenges, and implications of AI implementation in supporting learning transformation in the digital era. Moreover, this study is expected to provide a comprehensive overview of the impact of AI-based interactive learning media on students' digital literacy and HOTS, offer

theoretical and empirical foundations for the development of AI-based instructional strategies in the future, and identify research gaps that may serve as directions for further studies.

RESEARCH METHODS

This study employed a qualitative approach using a literature review method, commonly referred to as library research. According to John W. Creswell (2013), qualitative research is a method used to explore and understand the meanings that individuals or groups assign to social or human problems. Meanwhile, Bogdan and Taylor (as cited in Mamik, 2015, p. 3) define qualitative research as a research procedure capable of producing descriptive data in the form of written or spoken words, as well as observable human behavior.

Accordingly, this study utilized a literature review of various nationally and internationally indexed scientific publications, including journals such as *The Impact of Adaptive and Interactive AI Tools on Student Learning: From Digital Literacy to Advanced Skills* and *Exploring the Level of AI Digital Literacy and Creative Thinking Skills in High School Students*. The collected data were derived from reference materials covering experimental and theoretical studies related to Artificial Intelligence (AI), digital literacy, and Higher-Order Thinking Skills (HOTS).

This research adopted a descriptive qualitative approach because it is considered appropriate for exploring empirical findings from previous studies and synthesizing them into a systematic conceptual understanding. The sources and types of data used in this study were secondary literature sources, including national and international journal articles. A total of 40 articles were initially collected and subsequently narrowed down to 13 scientific articles, consisting of eight nationally indexed articles and five internationally indexed articles, along with credible online sources discussing AI in education, digital literacy, and HOTS.

All data analyzed in this study were obtained from literature sources and other documentation materials, such as journal articles and other relevant media publications. The study focused on primary data in the sense that the information was obtained directly from the main references discussing the research topic. Data collection was conducted through scientific literacy methods by reviewing books, research journals, and published online academic sources.

The criteria for selecting the literature sources were as follows: Published within the period of 2020–2025; Containing keywords such as artificial intelligence, digital literacy, and higher-order thinking skills; and published in journals with ISSN accreditation.

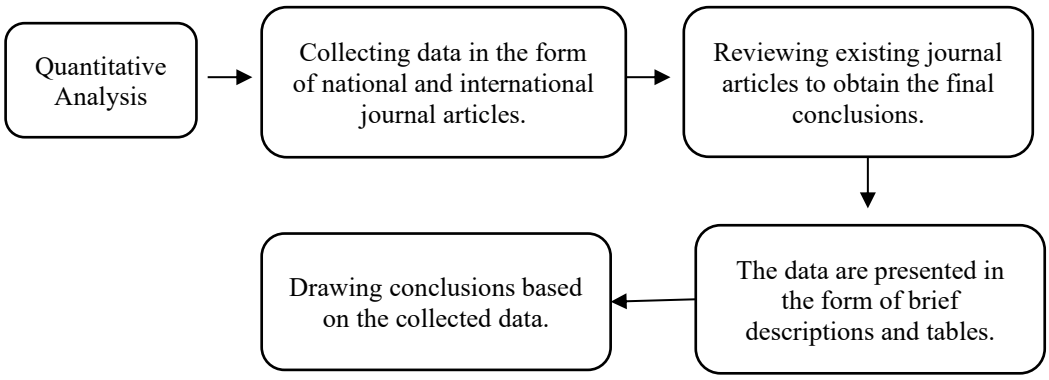

Figure 1. Flowchart of Interactive Model Qualitative Data Analysis.

The data collection technique employed in this study involved identifying and gathering sources or literature relevant to the research focus, particularly research journals related to the issue under investigation. The data analysis technique used in this study was conducted through literature analysis using deductive reasoning and by selectively reviewing the collected data. Through this process, the researcher obtained information regarding the influence of Artificial Intelligence on improving students' digital literacy and Higher-Order Thinking Skills (HOTS).

The search process was conducted to answer the research questions through relevant sources that could serve as references. In this study, literature related to the influence of Artificial Intelligence on enhancing digital literacy and Higher-Order Thinking Skills (HOTS) was systematically explored. Data collection was carried out by searching for information from various platforms, including Google Scholar, Garuda, ScienceDirect, Google Play Books, Scopus, Scribd, Oxford Journals, and other relevant sources.

The inclusion and exclusion criteria were used to determine the eligibility of the identified data for use in the Systematic Literature Review (SLR). A study was considered eligible if it met the following criteria:

1. The publication was issued within the period of 2020–2025;
2. The journal articles were written in either Indonesian or English;
3. The studies focused on improving students' digital literacy and Higher-Order Thinking Skills (HOTS);
4. The type of journal article was relevant to the selected research topic; and
5. The journal articles were available in full text and indexed.

Data Collection

At this stage, all required data for the study were collected and subsequently analyzed to address the predetermined research questions.

Data Analysis Technique

According to Sugiyono (2013), data analysis is the process of systematically organizing and examining data by categorizing information, identifying units of analysis, arranging them into patterns, selecting relevant findings, and drawing conclusions that are understandable to both researchers and readers. After all data had been selected and filtered according to the research objectives, the next step involved analyzing the data to obtain meaningful and comprehensible information.

Once the selected journals met the established criteria, they were classified based on several aspects, including the researcher's name, country of origin, year of publication, research title, and summary of findings. To ensure clarity and relevance, both the abstracts and full-text articles were carefully read, reviewed, and examined. Subsequently, the journal summaries were analyzed according to the study objectives and research findings. The collected data were then compared to identify similarities and differences, which ultimately formed the basis for drawing conclusions.

RESULTS AND DISCUSSION

Table 1 presents several national and international research articles related to the implementation of Artificial Intelligence-based interactive learning in improving students' digital literacy and Higher-Order Thinking Skills (HOTS).

Table 1. List of Sample Journal Articles Analyzed Related to Artificial Intelligence-Based Interactive Learning for Enhancing Digital Literacy and Higher-Order Thinking Skills (HOTS)

No	Source	Author	Title	Journal Analysis
				Result
1	Jurnal Pendidikan Multidisipliner Tahun 2025 e-ISSN 3063-1661	Muh. Zaini, Iskandar, Maslahatul Wardani, Musni Gina	The Integration of Artificial Intelligence in Learning and Its Impact on Students' Digital Literacy and Critical Thinking Skills.	The use of Artificial Intelligence (AI) in education opens new opportunities to create more engaging and relevant learning experiences, thereby contributing to the improvement of students' digital literacy and critical thinking skills.
2	Jurnal Teknodik Vol. 28 - Nomor 2, Desember Tahun 2024 ISSN: 2088 - 3978 e-ISSN: 2579-4833	Supriyadi, Zainuddin Nasution, Ayu Nurul Amalia	Artificial Intelligence (AI) Technology and Students' Digital Literacy on Learning Outcomes in the Learning Evaluation Course.	Artificial intelligence (AI) technology has a positive effect on students' learning outcomes in the Learning Evaluation course.
3	Jurnal Ilmu Pendidikan dan Pembelajaran Vol 01, No 02, 56-65 Tahun 2023 ISSN: 2088 - 3978 e-ISSN: 2579-4833	Qori Aina dan Eko Hariyono	The Implementation of PhET Simulations in Physics Learning to Improve the Scientific Literacy Skills of Tenth-Grade Senior High School Students.	The Problem-Based Learning model assisted by a virtual laboratory (PhET Simulations) can improve students' scientific literacy skills.
4	Jurnal Karya Ilmiah Guru Vol.7, No.1, Januari Tahun 2022 p-ISSN 2527-5712; e-ISSN 2722-2195	Dzulfiqar Satria Waliyuddin, Dwi Sulisworo	Test Instrument for Higher-Order Thinking Skills and Digital Literacy Skills.	The items developed in the test instrument generally demonstrated a moderate level of difficulty.
5	Jurnal Pendidikan Ekonomi (JUPE) Vol. 13 No. 2 Tahun 2025 p-ISSN: 2337-5752 e-ISSN : 2720-9660	Cindy Hanna Tasya, Khresna Bayu Sangka, Dini Octor	The Influence of Artificial Intelligence (AI) Utilization on Students' Learning Motivation with Digital Literacy as a Moderating Variable.	The utilization of Artificial Intelligence (AI) has a positive and significant effect on students' learning motivation.
6	Jurnal Pendidikan Nusantara Tahun 2025 P-ISSN:2502-4272 E-ISSN:3032-4009	Aris Zaputra, Kartika Selytias Utami, Aprianty, Rahmat Barona, Adnin AS, Jasmadi	Strategies for Enhancing Students' Digital Literacy through the Controlled Use of Artificial Intelligence (AI) at Al Washliyah Darusalam University, Banda Aceh.	This study provides practical contributions for educational institutions in formulating adaptive, responsible, and technology-based learning policies.
7	Jurnal Ilmiah Biologi Vol. 13, No. 1 Maret Tahun 2025 e-ISSN: 2654-4571	Nofamataro Zebua, Ibrohim, Sulisetijono	Exploring the Level of AI (Artificial Intelligence) Digital Literacy and Creative Thinking Skills among Senior High School Students.	The use of interactive AI tools and project-based learning models can serve as effective solutions to enhance both skills. A learning environment that supports exploration, along with positive feedback from teachers, is

No	Source	Author	Title	Journal Analysis Result
				also essential for creating optimal synergy.
8	International Journal of Innovative Research and Scientific Studies, 8(6) Tahun 2025 ISSN: 2617-6548	Ali Ateeq, Nasser A. Saif Almuraqab, Mohanad Alfiras, Mohammed Elastal, Rima Hassan Bin Saeed	The Impact of Adaptive and Interactive AI Tools on Student Learning: From Digital Literacy to Advanced Skills.	Interactive AI, adaptive learning platforms, and digital literacy significantly influence the development of students' skills.
9	International Journal of Instruction Vol.17, No.1 January Tahun 2024 p-ISSN: 1694-609 e-ISSN: 1308-1470	Maroua Rogt	The Effect of Mobile-Based Interactive Multimedia on Thinking Engagement and Cooperation.	Mobile-based interactive multimedia has a significant effect on thinking engagement and cooperation.
10	Jurnal Pendidikan Anak Usia Volume 8 Issue 6 Pages 1837-1846 Tahun 2024 ISSN: 2549-8959	Tongam E. Panggabean, Sofan Rizki, Abul Walid, Dawi Yanti, Ika Agustina, Marlen Wariunsora, Abdurahman Mas'ud, Tomi Apra Santosa	The Effect of Mobile Learning on the Critical Thinking Skills of Prospective Early Childhood Education Teachers: A Meta-Analysis (2021–2024).	Mobile learning is effective in improving the critical thinking skills of prospective early childhood education teachers.
11	Jurnal Nakula: Pusat Ilmu Pendidikan, Bahasa dan Ilmu Sosial Volume 3, Nomor 3, Mei Tahun 2025 e-ISSN: 3024-9945; p-ISSN: 3025-4132, Hal. 47-65	Muhammad Ryzki Tristiano, Aditya Syahban Nugraha, Adhika Ramdani, Adezian Santiago Nababan	The Influence of Artificial Intelligence (AI) in the Evaluation of Indonesian Language Learning.	AI has proven effective in helping students understand difficult materials.
12	Premiere Educandum: Jurnal Pendidikan Dasar dan Pembelajaran Volume 14 (1) 27 – 39 June Tahun 2024 ISSN: 2088-5350 / ISSN: 2528-5173	Ismail, Rahmat, Junaedi, Ita Sarmita, Suarti Djafar	Deep learning through educational games can effectively improve literacy outcomes in resource-limited environments.	Deep learning through educational games can effectively improve literacy outcomes in resource-limited environments.
13	Unisan Jurnal Manajemen dan Pendidikan Vol. 03 No. 11 Tahun 2024 e-ISSN: 2964-0131 p-ISSN – 2964 – 1748	Reni Dwi Puspitasari	The Integration of Digital Literacy Intelligence in Physics Science Learning to Improve Students' Critical Thinking Skills.	The use of interactive digital media can enhance students' cognitive abilities, particularly in the areas of conceptual understanding and analysis.

This study employed a descriptive qualitative approach through a literature review of 40 scientific articles, which were subsequently narrowed down to 13 selected articles published between 2020 and 2025. The reviewed sources consisted of nationally accredited journals indexed by Sinta and internationally reputable journals indexed by Scopus and WoS. The focus of the study was directed toward the implementation of Artificial Intelligence (AI)-based interactive learning media in improving students' digital literacy and Higher-Order Thinking Skills (HOTS). Based on the literature analysis, several major findings were identified as follows:

1) Improvement of Digital Literacy

The majority of the reviewed studies indicate that the use of AI-based learning media, such as Canva AI, Gamma App, QuillBot, PhET Simulation, ChatGPT, and AI-based simulations, significantly improves students' digital literacy skills. This improvement occurs because students are trained to interact with digital systems independently and critically. AI-based learning processes require students to develop digital information navigation skills and evaluate online learning resources critically. In addition, AI enables rapid feedback and personalized learning experiences that strengthen students' understanding of digital concepts.

2) Improvement of Higher-Order Thinking Skills (HOTS)

The literature review also demonstrates a positive relationship between the implementation of interactive AI media and the development of higher-order thinking skills, including the abilities to analyze, evaluate, and create. AI media such as adaptive learning systems encourage students to solve problems independently through intelligent feedback mechanisms. Furthermore, AI supports the implementation of project-based learning and inquiry-based learning models, both of which have been proven effective in fostering HOTS development.

3) The Relationship Between Digital Literacy and HOTS

The synthesis of the literature reveals that digital literacy and HOTS mutually reinforce one another. Digital literacy serves as a foundation for higher-order thinking because it enables students to access, evaluate, and integrate digital information effectively. Conversely, HOTS helps students think critically about the AI technologies they utilize.

Studies conducted by Mulyani (2024) and Zhang (2023) concluded that AI-based learning designed using constructivist and collaborative approaches can simultaneously enhance both digital literacy and HOTS.

4) Challenges and Inhibiting Factors

Several challenges were identified in the implementation of AI-based learning media. Teachers' readiness to understand and operate AI technology remains limited, while digital infrastructure in some schools is still inadequate. In addition, students' overreliance on technology may reduce reflective thinking if not properly guided. There is also a tendency toward cognitive dependency on AI, which may weaken students' reflective abilities when pedagogical supervision is lacking. Therefore, AI can function effectively as a reflective learning medium only when supported by instructional designs based on open-ended questioning and active teacher guidance.

The findings of this study emphasize that AI-based interactive learning media

possess transformative potential for 21st-century educational practices. The implementation of AI technology functions not only as a supporting tool but also as an adaptive learning partner capable of understanding students' learning styles and dynamically adjusting instructional materials. Within the context of the *Merdeka Curriculum*, digital literacy represents one of the essential 21st-century competencies, encompassing the ability to access, evaluate, and utilize digital information appropriately. AI plays a crucial role in expanding opportunities for independent and collaborative learning.

These findings are consistent with the theory of Connectivism proposed by George Siemens (2005), which emphasizes the importance of connections between individuals and digital information networks. Through AI, students learn how to build and manage complex digital knowledge networks.

In the context of Higher-Order Thinking Skills (HOTS), the use of interactive AI media is also aligned with Bloom's Taxonomy Revised by Lorin Anderson and David Krathwohl (2001), which places the ability to create at the highest level of cognitive processes. AI, particularly through simulations and data-driven problem-solving activities, provides broad opportunities for students to practice critical and creative thinking.

Nevertheless, although AI utilization has the potential to increase learning motivation, it should not be regarded as the sole determining factor. AI systems still possess limitations due to their ongoing development, while learning motivation itself is influenced by multiple complex factors. Digital literacy acts as a negative moderator by preventing excessive dependence on AI through students' abilities to evaluate and investigate the credibility of information. Consequently, AI can be utilized optimally and wisely as a learning support tool while minimizing negative impacts, such as reduced learning motivation or weakened critical thinking skills resulting from overdependence on AI.

In addition to mentoring, digital campaigns, and training programs aimed at improving students' digital literacy and efficient AI utilization skills, educators and educational institutions also play essential roles in supporting responsible AI integration (Cindy Hanna Tasya, 2025).

5) Integration of AI, Digital Literacy, and HOTS

The integration of AI, digital literacy, and HOTS can be explained through the TPACK Framework (*Technological Pedagogical Content Knowledge*). Teachers are required to master not only content knowledge and pedagogy but also the effective utilization of AI technology. The literature review indicates that teachers who understand TPACK principles are more likely to design instructional processes that simultaneously promote HOTS and digital literacy development.

CONCLUSION

Overall, this literature review demonstrates that Artificial Intelligence (AI)-based interactive learning media have a positive impact on improving students' digital literacy and Higher-Order Thinking Skills (HOTS). However, the success of its implementation is strongly influenced by several factors, including teachers' competencies, the readiness of digital infrastructure, and the application of student-centered pedagogical designs.

Therefore, this study reinforces the importance of developing a well-structured and adaptive AI-based learning ecosystem as

part of a national strategy to improve the quality of education in the digital era.

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