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Integration of Artificial Intelligence and Human-Computer Interaction in Digital Learning Systems to Improve the Quality of Student Interaction

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ABSTRACT

This study aims to analyze the integration of artificial intelligence and human-computer interaction in digital learning systems to improve the quality of student interaction. The study addresses the growing use of AI-based features in higher education, including chatbots, automated feedback, learning recommendations, and digital learning management systems. A qualitative case study approach was used to explore students' experiences, perceptions, and interaction patterns in using AI-supported digital learning platforms. Data were collected through semi-structured interviews, non-participant observation, and documentation. The participants consisted of 15 to 20 students from different study programs, 3 to 5 lecturers, and one platform administrator selected through purposive sampling, with snowball sampling used when additional relevant informants were needed. Data were analyzed using reflexive thematic analysis through transcription, repeated reading, initial coding, theme development, theme review, and interpretation. The findings reveal four main themes: AI as immediate academic support, interface clarity as a condition for meaningful interaction, trust and control in AI-assisted learning, and the transformation of student interaction from passive access to active engagement. These findings show that AI can improve student interaction when supported by clear interface design, lecturer guidance, ethical rules, and reflective learning activities. The study contributes to AI-based education research by emphasizing the importance of human-centered design in digital learning. Future research should examine AI and HCI integration across broader institutional and disciplinary contexts.

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1. Introduction

The development of artificial intelligence in digital education has changed the way students access learning materials, receive feedback, participate in discussions, and build learning experiences. Digital learning systems no longer function only as repositories for learning materials. These systems are increasingly developing into adaptive learning environments that can provide recommendations, monitor learning progress, and assist students through automated features. Hwang et al. (2020) emphasized that AI in education plays an important role in learning personalization, learning process analysis, and pedagogical decision support. Chen et al. (2020)

also showed that the development of AI in education still faces a gap between technological application and learning theory. This condition indicates that AI integration in digital learning should be viewed as a pedagogical, technological, and social issue.

In digital learning, the quality of student interaction depends not only on the availability of the platform. It is also shaped by interface design, navigation clarity, ease of use, system responsiveness, and students' trust in technology. Human-Computer Interaction is important because this approach places user experience at the center of system design. Yang et al. (2021) explained that AI development in education must remain human-centered so that technology does not reduce learners' agency. Ouyang and Jiao (2021) classified the role of AI in education into three paradigms, namely AI-directed, AI-supported, and AI-empowered learning. This classification shows that AI can guide, support, or empower learning, but its design must still maintain the active role of students.

Field problems show that the use of digital learning systems does not always produce meaningful learning interaction. Students can access materials quickly, but discussion forums often remain formal and lack dialogue. Automated feedback also does not always meet students' personal needs. Seo et al. (2021) showed that AI can influence interaction between students and instructors in online learning, especially through communication support, academic responses, and perceived instructor presence. Okonkwo and Ade-Ibijola (2021) found that educational chatbots can help students obtain information quickly. However, chatbot benefits depend on design quality, pedagogical context, and the relevance of system responses.

This issue is increasingly relevant in Indonesian higher education. Universities have started using learning management systems, blended learning platforms, chatbots, learning analytics, and generative applications to support academic activities. Herawati et al. (2024) showed that Indonesian students have diverse perceptions and preferences toward AI use in education. Some students view AI as a tool that accelerates information searching and material comprehension. Others remain concerned about answer accuracy, academic ethics, and dependency risks. Al Mashagbeh et al. (2025) also found that student engagement with AI tools is related to the use of chatbots and intelligent conversational applications in academic activities. These findings show that the main issue is not only the use of AI, but also how AI is designed to strengthen active, reflective, and responsible learning interaction.

Previous studies have widely discussed AI in education from the perspectives of opportunities, challenges, effectiveness, and technological development. Khosravi et al. (2022) emphasized the importance of explainable AI so that system decisions can be understood by users. Crompton and Burke (2023) showed that research on AI in higher education is growing rapidly, but it still needs stronger attention to ethics, user context, and learning practices. Kasneci et al. (2023) explained that large language models provide major opportunities to support learning, but they also create risks related to accuracy, academic integrity, and user dependency. Chiu et al. (2023) emphasized that research on AI in education needs to examine opportunities, challenges, and future research needs in a more contextual way. However, most studies still position AI as a tool or automated system, not as an interaction experience that students directly interpret.

Based on this gap, this study aims to analyze the integration of artificial intelligence and human-computer interaction in digital learning systems to improve the quality of student interaction. The study focuses on students' experiences in using AI features, their perceptions of system usability, feedback quality, interface clarity, and forms of engagement that emerge during digital learning. Alfredo et al. (2024) emphasized that learning analytics and AI need to be developed through a human-centered approach so that systems are not only technically accurate, but also pedagogically relevant. Ma et al. (2023) showed that the HCI approach can help explain learning engagement through cognitive, emotional, and visual experiences in online learning environments. Therefore, this study is expected to contribute theoretically to the development of AI-based HCI studies in digital education. Practically, the results can provide input for lecturers,

platform developers, and higher education institutions in designing digital learning systems that are more interactive, transparent, adaptive, and student-centered.

2. Materials and Methods

This study uses a qualitative approach with a case study design. This design was selected because the study focuses on developing an in-depth understanding of the integration of artificial intelligence and human-computer interaction in digital learning systems within the real context of higher education. A case study is relevant when researchers seek to understand a phenomenon in detail within a specific social environment, especially when the boundaries among systems, users, and learning processes are interconnected. Bond et al. (2024) emphasized that research on AI in higher education needs stronger ethics, collaboration, and methodological rigor. Therefore, a qualitative approach was selected to explore students' experiences, meanings, perceptions, and interaction processes in greater depth.

The study was conducted at a higher education institution in Indonesia that has used digital learning platforms and AI-based features in academic activities. The research was planned for three months, from March to May 2025. The research site was selected because it has active digital learning activities, uses a learning management system, and involves students in the use of AI features such as chatbots, automated search, material recommendations, and digital feedback. Bergdahl (2022) showed that student engagement and disengagement in online learning are complex and influenced by the learning context. For this reason, this study positions institutional context, system design, and student experience as important parts of the data collection process.

Participants were selected using purposive sampling. This technique was used because the researcher needed informants who had direct experience using AI-based digital learning systems. The main informant criteria included active students who had used a digital learning platform for at least one semester, had interacted with AI features in the learning process, and were willing to provide information openly. The main informants were planned to consist of 15 to 20 students from different study programs. This study also involved 3 to 5 lecturers and 1 platform administrator as supporting informants. When initial data did not sufficiently explain variations in student experience, the researcher used snowball sampling through recommendations from relevant informants. This strategy was used to obtain richer data, especially regarding differences in students' experiences of using AI.

Data were collected through semi-structured interviews, non-participant observation, documentation, and method triangulation. Semi-structured interviews were used to explore students' experiences related to system usability, interface clarity, quality of AI responses, trust in system outputs, and barriers experienced during digital learning. Non-participant observation was conducted by examining platform usage patterns, how students navigated AI features, responses to automated feedback, and interaction patterns in digital forums. Documentation was carried out by reviewing platform user guides, feature screenshots, task instructions, discussion histories, and policies on AI use in learning. Essel et al. (2022) showed that chatbots can support student learning when systems provide relevant and accessible assistance. Debets et al. (2025) also emphasized that educational chatbots need to be evaluated based on their objectives, theoretical foundations, technology, and impact on learning behavior.

Data validation was conducted through source triangulation, method triangulation, member checking, and audit trail. Source triangulation was carried out by comparing data from students, lecturers, and the platform administrator. Method triangulation was conducted by comparing interview, observation, and documentation findings. Member checking was conducted by returning interview summaries or initial interpretations to informants to ensure the accuracy of meaning. McKim (2023) emphasized that member checking needs to be structured so that it does not become merely a formal confirmation. An audit trail was conducted by storing interview

guidelines, observation notes, transcripts, analytical memos, coding decisions, and theme revisions throughout the research process. Carcary (2020) explained that an audit trail helps maintain transparency in qualitative research. Ahmed (2024) also emphasized that credibility, transferability, dependability, and confirmability need to be maintained through documentation and researcher reflexivity.

Data analysis used reflexive thematic analysis. The analysis process began with interview transcription, repeated reading, initial coding, code grouping, preliminary theme development, theme review, theme naming, and final interpretation. Initial codes focused on issues such as ease of use, interface clarity, feedback quality, trust in AI, system responsiveness, student engagement, and ethical challenges in digital learning. Braun and Clarke (2021) emphasized that the quality of thematic analysis depends on consistency among research questions, theoretical position, coding process, and theme development. Kiger and Varpio (2020) explained that thematic analysis helps researchers identify, organize, and interpret patterns of meaning in qualitative data. Byrne (2022) strengthened this view by explaining that reflexive thematic analysis allows researchers to develop themes systematically through active engagement with the data. Ayre and McCaffery (2022) also emphasized the importance of transparency in theme development so that the analytical process can be traced. Through these procedures, this study is expected to produce an in-depth understanding of how AI and HCI integration shapes the quality of student interaction in digital learning systems.

3. Results and Discussions

The findings show that the integration of artificial intelligence and human-computer interaction in digital learning systems shaped student interaction through four main themes. These themes were identified from semi-structured interviews, non-participant observation, and documentation of learning activities. The four themes include AI as immediate academic support, interface clarity as a condition for meaningful interaction, trust and control in AI-assisted learning, and the transformation of student interaction from passive access to active engagement. These themes indicate that the quality of student interaction did not depend only on the availability of AI features. It also depended on how students understood, trusted, and used these features in real learning situations.

The first theme shows that AI functioned as immediate academic support for students. Most participants explained that AI features helped them search for information, understand difficult concepts, and obtain quick responses outside formal class hours. Students felt that AI reduced waiting time when they needed clarification about learning materials. One participant stated, “AI helps me when I do not understand a topic at night, especially when the lecturer has not responded in the discussion forum” (Participant 4). This finding was also supported by observation data, which showed that students often used chatbot features before asking questions in class forums. However, this support did not replace the role of lecturers. Students still needed lecturer confirmation when AI responses were unclear, too general, or different from the material taught in class.

The second theme relates to interface clarity and ease of navigation. Students reported that AI-based features were useful when they were easy to find, simple to operate, and connected directly to learning activities. Features placed inside the learning management system were used more often than external applications because students did not need to move between many platforms. One participant explained, “I use the AI feature more often when it is already in the LMS because I can open the material, ask questions, and return to the assignment page quickly” (Participant 8). Observation results showed that students with better digital literacy interacted more actively with AI features. In contrast, students who struggled with menu structure, unclear icons, or technical terms tended to avoid these features. This pattern shows that human-computer interaction plays a central role in determining whether AI can support learning interaction.

The third theme concerns trust, accuracy, and student control. Students did not fully accept AI responses without evaluation. Several participants stated that they compared AI-generated answers with lecture notes, journal articles, or lecturer explanations. One participant said, "I do not directly copy the AI answer. I usually check whether the explanation fits the lecture material" (Participant 11). This finding shows that students developed a selective attitude toward AI use. They used AI as a learning assistant, but they still expected human validation from lecturers. Documentation of learning guidelines also showed that lecturers encouraged students to cite academic sources and avoid submitting AI-generated responses without revision. This condition reflects a growing awareness that AI use in education requires ethical control, source evaluation, and academic responsibility.

The fourth theme shows a shift in student interaction patterns. AI features encouraged some students to become more active in asking questions, exploring materials, and preparing for class discussions. Students who previously felt reluctant to ask questions directly to lecturers used AI as an initial space to test their understanding. One participant stated, "I feel more confident joining the discussion after asking AI first, because I already have a basic idea" (Participant 2). However, the findings also show a potential risk of reduced peer interaction. Some students preferred asking AI rather than discussing with classmates because AI gave faster responses. This pattern indicates that AI can strengthen individual learning interaction, but it may also reduce collaborative learning if the system design does not encourage peer dialogue.

Observation data further showed that meaningful interaction occurred when AI features were connected with lecturer guidance, discussion activities, and reflective assignments. Students used AI more productively when lecturers gave clear instructions on how to ask questions, verify answers, and transform AI responses into academic arguments. In classes where lecturers did not provide guidance, students tended to use AI only for quick answers. This finding suggests that AI integration needs pedagogical design, not only technical availability. The quality of interaction improved when the system, lecturer, and student roles were aligned within the digital learning process.

Overall, the results show that AI and HCI integration can improve the quality of student interaction when the system is accessible, transparent, easy to use, and connected to learning goals. Students valued AI features that provided quick support, but they also needed clear interface design, lecturer guidance, and ethical boundaries. The findings indicate that student interaction in digital learning is shaped by the relationship between technological features, user experience, academic culture, and institutional learning practices.

Discussion

The findings support the view that AI in education should not be treated only as a technical tool. AI becomes meaningful when it supports student agency, interaction, and learning reflection. This result aligns with Yang et al. (2021), who emphasized the importance of human-centered AI in education. The findings also strengthen Ouyang and Jiao's (2021) argument that AI can support and empower learning when students remain active participants in the learning process. In this study, students did not use AI only to receive answers. They used it to clarify concepts, prepare questions, evaluate responses, and build confidence before interacting with lecturers or peers.

The finding that AI served as immediate academic support is consistent with previous research on educational chatbots. Okonkwo and Ade-Ibijola (2021) found that chatbots can support access to information and learning assistance. Essel et al. (2022) also showed that virtual teaching assistants can help students in higher education when they provide relevant and accessible support. However, this study adds a contextual finding that AI support was most effective when it remained connected to lecturer guidance. Students still positioned lecturers as sources of academic authority. This means that AI can expand learning support, but it cannot fully replace pedagogical presence.

The finding on interface clarity confirms the importance of human-computer interaction in digital learning systems. Students were more willing to use AI features when the interface was clear, simple, and integrated into the LMS. This finding supports Ma et al. (2023), who showed that user-centered HCI can help explain learning engagement in online environments. It also relates to Alfredo et al. (2024), who argued that learning analytics and AI should be developed through a human-centered approach. In this study, poor navigation and unclear feature placement reduced student interaction. This suggests that AI effectiveness depends not only on algorithmic performance, but also on interface quality and user experience.

The issue of trust and control also reflects a major concern in AI-based learning. Students in this study showed caution toward AI responses. They compared AI outputs with lecturer explanations and academic sources. This finding aligns with Khosravi et al. (2022), who emphasized the importance of explainable AI in education. It also supports Kasneci et al. (2023), who warned that large language models create opportunities and risks related to accuracy, academic integrity, and dependency. The present study shows that students can develop responsible AI use when lecturers provide guidance and when institutions create clear ethical rules. Without such guidance, students may treat AI as a shortcut rather than a learning partner.

The findings also show a tension between individual and collaborative learning. AI helped students become more confident and independent. At the same time, some students reduced peer discussion because AI provided faster responses. This finding extends previous studies by showing that AI may produce different effects on interaction quality. It can increase student-system interaction and student-content interaction, but it may weaken student-student interaction if collaborative activities are not intentionally designed. Seo et al. (2021) found that AI can influence learner-instructor interaction in online learning. This study adds that AI may also reshape peer interaction and classroom participation patterns.

From a theoretical perspective, this study contributes to the integration of AI in education and HCI by showing that student interaction is shaped by three connected dimensions. The first dimension is technological, which includes AI response quality, feature accessibility, and system integration. The second dimension is experiential, which includes ease of use, trust, confidence, and perceived usefulness. The third dimension is pedagogical, which includes lecturer guidance, ethical instruction, discussion design, and reflective tasks. These dimensions show that AI integration in digital learning systems requires more than technical adoption. It requires a human-centered learning design that connects system features with student needs and academic values.

From a practical perspective, the findings suggest that higher education institutions need to design AI-based digital learning systems with clear user pathways, transparent responses, and strong academic guidance. Lecturers need to help students use AI for exploration, clarification, and reflection, not only for answer generation. Platform developers need to ensure that AI features are easy to access, visually clear, and connected to learning activities. Institutions also need to create ethical guidelines that regulate AI use in assignments, discussion forums, and academic writing. These steps can help prevent dependency while still supporting student engagement.

This study also has implications for future research. Further studies can compare student experiences across different universities, disciplines, and levels of digital literacy. Quantitative studies can test the relationship between AI usability, student trust, interaction quality, and learning outcomes. Future research can also examine lecturer perspectives, institutional policy, and platform design in more detail. Longitudinal studies are needed to understand whether AI improves student interaction over time or only provides short-term convenience. These future directions can deepen understanding of how AI and HCI can support digital learning that is interactive, ethical, and student-centered.

4. Conclusions

This study concludes that the integration of artificial intelligence and human-computer interaction in digital learning systems can improve the quality of student interaction when AI features are designed to be accessible, transparent, easy to use, and connected to learning goals. The findings show four main patterns. AI served as immediate academic support, interface clarity influenced student willingness to interact with the system, trust and control shaped responsible AI use, and AI changed student interaction from passive access to more active engagement. However, the findings also show that AI cannot stand alone as a learning solution. Student interaction improved when AI features were supported by lecturer guidance, ethical rules, reflective tasks, and system design that encouraged both individual and collaborative learning.

Theoretically, this study contributes to the development of AI-based learning studies by linking artificial intelligence, human-computer interaction, and student-centered digital pedagogy. Practically, the findings suggest that universities, lecturers, and platform developers need to design digital learning systems that do not only focus on automation, but also on usability, trust, feedback quality, and meaningful interaction. From a policy perspective, higher education institutions need clear guidelines for ethical AI use in learning, assignments, and academic communication. Future research can examine this issue across different universities, disciplines, and digital literacy levels. Further studies can also use mixed methods to measure the relationship between AI usability, student trust, interaction quality, and learning outcomes.

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