



Learning in the Presence of Machines: A Study of Student Interactions with AI-Based Educational Tools

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ABSTRACT

Artificial Intelligence (AI) has become increasingly embedded in educational technology, particularly through AI-based tutoring systems that support autonomous learning in higher education. While the functionality and effectiveness of these systems have been widely studied, less is known about how students subjectively experience and make meaning of their interactions with AI tutors. The present study addresses this gap by asking: how do university students experience AI-based tutoring in self-directed learning environments? Conducted at a public university in Indonesia, this research explores the lived experiences of twelve undergraduate students engaged with AI tutoring systems over a semester. Data were collected through in-depth semi-structured interviews and analyzed using Interpretative Phenomenological Analysis (IPA), revealing four major experiential themes: negotiating autonomy, emotional ambivalence, forming quasi-social connections, and tensions between efficiency and personalization. The results show that students construct complex emotional and cognitive relationships with AI tutors that extend beyond functional use, influencing their motivation, engagement, and perceived support. These findings demonstrate the need to view AI not merely as a technical tool but as a relational agent within the learning experience. By uncovering the essence of learner-AI interaction, this study contributes to a deeper understanding of the human dimensions of digital learning and provides guidance for developing more empathetic, learner-centered AI technologies in education.



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INTRODUCTION

In recent years, the integration of artificial intelligence (AI) into educational technology has reshaped digital learning, particularly through AI-based tutoring systems that support personalized and autonomous learning in higher education (Saidon dkk., 2022). These systems not only enhance efficiency and feedback but also influence students' emotional and cognitive engagement.

Although much research has explored the technical benefits of AI tutors, less attention has been given to how students subjectively experience these systems. Existing studies often rely on quantitative metrics, which may overlook deeper psychological and relational dimensions of learning with AI (Solihatin & Situmorang, 2024).

As AI tutors become integral to e-learning environments, understanding how students interpret and internalize their interactions is increasingly important. Prior research has emphasized usability and performance, yet neglected how learners construct meaning, experience autonomy, or form emotional connections with AI agents. This gap is particularly evident in studies that prioritize external outcomes over the nuanced realities of learner experience (Sya dkk., 2022; Tu dkk., 2023).

To address this, a phenomenological approach is warranted—one that foregrounds the lived experiences of learners rather than technical outputs. Interpretative Phenomenological Analysis (IPA)

enables a deep exploration of how students perceive and emotionally engage with AI tutors in real-life academic settings.

This study, therefore, investigates how undergraduate students at a public university in Indonesia experience AI-based tutoring in self-directed learning environments. By centering students' narratives, it seeks to illuminate the affective and existential aspects of AI-mediated learning. This contribution not only advances theoretical understanding but also offers practical insights for designing more human-centered educational technologies.

RESEARCH METHODS

Study Design

This study employed an interpretative phenomenological approach to explore the subjective experiences of university students in interacting with AI-based tutoring systems within independent learning contexts. Phenomenology was chosen due to its focus on understanding lived experiences and capturing the essence of how individuals perceive and make sense of particular phenomena (Bhutta dkk., 2024). The interpretative orientation, rooted in Heideggerian philosophy, emphasized the co-construction of meaning between participants and the context in which their experiences occurred. This design was appropriate for uncovering nuanced emotional, cognitive, and relational dimensions of learner-AI interactions—dimensions that are not adequately addressed by traditional empirical methods.

To ensure methodological rigor, this study followed the procedural steps outlined by Smith, Flowers, and Larkin (2009), which include detailed idiographic analysis and iterative meaning-making grounded in participants' narratives.

Participants

Participants consisted of undergraduate students actively engaged in e-learning environments that utilized AI-based tutoring systems. Selection followed purposive sampling, with the inclusion criteria requiring participants to have used AI tutoring platforms for at least one academic semester and to possess adequate digital literacy to reflect meaningfully on their experiences. Exclusion criteria involved students who had only briefly encountered AI tutoring or used the tools solely for non-academic purposes (Chen dkk., 2024). The final sample included 12 participants (7 females and 5 males), aged between 19 and 23 years, representing various academic disciplines. All participants demonstrated sustained engagement with AI tutors across multiple course modules.

Data Collection

Data were collected through in-depth semi-structured interviews, guided by a flexible interview protocol designed to elicit detailed personal accounts of interactions with AI tutors. Interviews were conducted face-to-face in quiet, comfortable university meeting rooms to facilitate open reflection and minimize distractions (Hsiao dkk., 2023). Each session lasted between 45 and 70 minutes, and all interviews were audio-recorded with the participants' consent. The interview guide was adapted from validated protocols in prior phenomenological studies and included open-ended questions that allowed for spontaneous elaboration. Efforts were made to establish rapport and ensure that participants felt safe sharing their authentic experiences.

Data Analysis

Interpretative Phenomenological Analysis (IPA) was used to examine the collected data. Transcribed interviews were read repeatedly to immerse in the data and identify meaningful units. These units were coded and clustered into emergent themes that captured essential aspects of the participants' lived experiences. The analytic process involved iterative comparison across transcripts to refine categories and ensure thematic coherence. Themes were then synthesized into overarching structures representing the shared meanings among participants. NVivo software supported data organization but did not replace the manual interpretive work required to generate nuanced insights.

Ethical Considerations

Ethical clearance was obtained from the institutional research ethics committee prior to data collection. Participants were fully informed about the study's purpose, their rights, and the voluntary nature of their participation (Kemp dkk., 2019). Written informed consent was secured before each interview. Anonymity was preserved by assigning pseudonyms, and all data were stored securely in encrypted digital formats. The research adhered to the ethical principles of the Declaration of Helsinki and applicable national ethical standards governing studies involving human subjects.

RESULTS

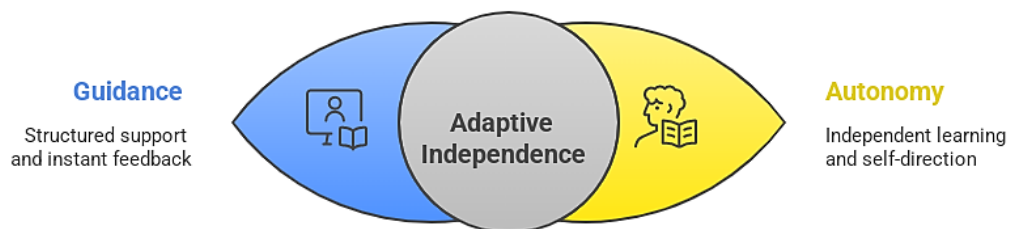
Navigating Between Guidance and Autonomy

Students often described their experience with AI tutors as a balancing act between receiving support and maintaining their learning autonomy. While the systems offered instant responses and structured explanations, some participants expressed discomfort with the rigidity of the interactions.

“The AI tutor helps me understand concepts quickly, but sometimes it feels like I’m talking to a wall—no emotions, no flexibility. I miss the spontaneity of a real discussion.” (P03)

This theme reveals that while students appreciated the responsiveness of the AI tutor, they simultaneously experienced a sense of detachment. They perceived the AI as efficient but emotionally disengaged, creating an ambiguous learning space that fostered independence but lacked human warmth.

The Balancing Act in AI-Assisted Learning



Emotional Ambivalence in Human-AI Interaction

Students reported a range of emotional reactions—from appreciation to frustration—when engaging with AI tutors. Emotional ambivalence was a recurring experience, especially when the system failed to recognize the nuance of their queries.

“Sometimes I feel the AI understands me, and other times it keeps giving irrelevant answers... it's frustrating, especially when I’m stressed before exams.” (P07)

This emotional variability underlines how the perceived intelligence and limitations of AI tutors influenced learners’ motivation and trust. Participants indicated that emotional resonance was missing, creating an affective void in their learning journey.

Developing Quasi-Social Bonds with the AI

Some students described experiencing a quasi-social connection with the AI tutor. Over time, the system was anthropomorphized as a consistent presence in their learning routine, leading to feelings of comfort or dependency.

“It’s strange, but I feel like the AI is always there for me. I even thank it sometimes after it helps me solve a tough problem.” (P12)

Despite knowing the tutor was non-human, students formed relational habits. This bond, though artificial, contributed to feelings of companionship and academic accountability, reflecting an evolving emotional dynamic between humans and intelligent systems.

Tensions Between Efficiency and Personalization

Participants acknowledged that AI tutors enhanced learning efficiency, particularly for reviewing material or solving structured problems. However, they also emphasized the system's lack of contextual understanding and adaptability.

“I get quick answers, yes, but when I try to ask ‘why’ or bring up something complex, it just repeats or redirects me to a different topic.” (P05)

This theme highlights the conflict between personalization needs and algorithmic constraints. The limitations in interpretive capability resulted in reduced learning depth for certain students, especially those who sought dialogical and critical engagement.

The students’ experiences reflect a multi-layered and often contradictory engagement with AI-based tutors. They oscillated between feeling empowered and constrained, connected and isolated, and motivated yet emotionally unfulfilled. These findings suggest that while AI tutors offer functional benefits, they also reshape the affective and relational dimensions of learning in complex ways that deserve deeper pedagogical consideration.

DISCUSSION

Summary of Main Findings

This study revealed that students' experiences with AI-based tutoring systems are marked by a complex interplay of autonomy, emotional ambiguity, and evolving human-technology relationships (Kharaba dkk., 2023). These findings directly respond to the central research question by uncovering how learners subjectively perceive, engage with, and assign meaning to their interactions with AI tutors during self-directed learning.

Contribution of Findings to the Research Question

The results offer a nuanced answer to the research question by showing that students' interactions with AI tutors transcend functional use and enter the realm of emotional and relational experience. Rather than viewing the AI as a mere instructional tool, many participants described forming quasi-social bonds, navigating emotional tensions, and negotiating their sense of agency within the constraints of algorithmic logic (Le & Do, 2019). These insights highlight a significant contribution to the understanding of AI in education—not as a neutral facilitator but as a participant in students’ meaning-making processes. The study thus deepens our grasp of how digital learning environments affect learners' perceptions, motivation, and cognitive-emotional engagement.

Relation to Previous Literature and Theoretical Frameworks

The findings resonate with earlier research suggesting that human-computer interactions can evoke emotional and relational responses (Reeves & Nass, 1996), yet they go further by situating these responses within the lived realities of learners navigating autonomy and technological support. The reported sense of frustration, dependency, and even companionship aligns with socio-cognitive theories of mediated learning but challenges assumptions in behaviorist frameworks that treat technology as a static input-output mechanism. Additionally, the results support interpretative phenomenological literature that emphasizes the co-construction of experience between human users and digital systems (Lin dkk., 2024). Compared to studies focused on usability or academic performance (Loder dkk., 2020), this research offers a deeper, more holistic view by exploring how learners internalize and make sense of AI tutoring in context.

Implications of the Findings

The findings of this study carry significant implications for educational design, particularly in the development of AI-based learning tools that are more empathetic and context-sensitive. From a sociocultural perspective, the emotional ambivalence and quasi-social bonds formed by students suggest that AI tutors are not just technical interfaces but evolving relational agents embedded in learners' academic and emotional landscapes. These insights call for a rethinking of how AI systems

are designed—not merely to optimize performance but to acknowledge the affective and interpretive dimensions of human learning. Practically, educational institutions and developers should consider integrating humanistic design elements that support student autonomy while also addressing emotional needs. These implications are especially relevant for diverse learning populations, including those in resource-limited or culturally nuanced educational settings where human support is scarce.

Study Limitations

Despite its contributions, this study is not without limitations. The use of purposive sampling and a relatively small number of participants limits the extent to which findings can be generalized across broader educational populations. Additionally, the study's interpretative phenomenological approach, while offering deep insight into subjective experience, inherently privileges depth over breadth. The context-specific nature of the AI tools used and the academic disciplines represented may also influence how experiences were articulated. These limitations, however, are consistent with the philosophical foundations of phenomenology, which seeks to illuminate rather than quantify human experience. Recognizing these boundaries allows for cautious interpretation while identifying directions for future inquiry.

Future Research Directions

Future studies may build upon these findings by exploring how diverse demographic or cultural factors shape learners' experiences with AI tutors, potentially using cross-cultural phenomenological comparisons. Longitudinal research could also examine how these experiences evolve over time and whether sustained interactions with AI systems lead to deeper psychological or pedagogical shifts (Maini dkk., 2021). Additionally, integrating phenomenological methods with other qualitative approaches, such as ethnography or narrative inquiry, may enrich the understanding of learner-technology interaction. Expanding this line of inquiry will contribute meaningfully to the field of educational technology by bridging human experience with digital innovation in a more ethical and empathetic way.

CONCLUSION

This study explored university students' lived experiences with AI-based tutoring systems in self-directed e-learning environments, addressing a gap in understanding the subjective dimensions of human-AI interaction. While the findings affirmed that learners navigate tensions between autonomy and algorithmic influence, they also uncovered deeper emotional and relational dynamics often absent in mainstream evaluations of educational technology. More than a summary of experiences, these insights prompt a conceptual shift: AI tutors should be understood not merely as instructional tools, but as dynamic actors within a student's learning ecology—affecting agency, motivation, and emotional well-being. This reframing invites educators, developers, and policymakers to move beyond performance metrics toward more holistic, learner-sensitive frameworks for AI integration. Methodologically, the use of interpretative phenomenology underscores the value of narrative-based approaches in revealing hidden layers of learner engagement—layers that quantitative studies may miss. As such, the study contributes to an evolving research agenda that centers human meaning-making in technology-enhanced education. Moving forward, future research should investigate how these dynamics play out across cultural, institutional, and disciplinary boundaries, and whether prolonged engagement with AI systems reshapes learners' epistemological beliefs, coping mechanisms, or identity development. By deepening our understanding of human-AI relations in education, such work may guide the ethical and empathetic design of next-generation learning technologies.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article. All procedures were conducted independently, and no personal or financial relationships influenced the integrity or objectivity of the research.

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