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Students' Experiences and Meaning-Making in AI-Based Adaptive Learning in Higher Education

Nurul Khafifah Pulungan [1]*, Yeni Erlinda Nora[2]
[1,2]UIN Imam Bonjol padang, Indonesia
[1]nurulkhafifahpulungan@gmail.com*, [2]yenierlindanora@gmail.com

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ABSTRACT

The rapid integration of AI-based adaptive learning platforms is reshaping higher education by personalizing learning experiences and transforming student engagement with digital technologies. However, while prior studies have predominantly focused on performance metrics and system efficiency, there remains a limited understanding of how students construct meaning and interpret their interactions with adaptive technologies. Addressing this gap, the present study aims to explore students' lived experiences and meaning-making processes within AI-driven adaptive learning environments. Using an interpretative phenomenological analysis (IPA), the research contributes methodologically by foregrounding subjective, emotional, and cognitive dimensions often overlooked in technology-enhanced learning studies. Data were collected through semi-structured interviews with twelve undergraduate students and analyzed thematically using IPA to identify shared and divergent patterns of meaning. The findings highlight four key themes: personalized learning trajectories, emotional adaptation and cognitive challenges, evolving student–technology relationships, and negotiation of control and autonomy. Students reported valuing personalization and adaptive feedback, yet also expressed concerns about increased dependency on algorithmic recommendations and diminished autonomy. This study advances the literature on adaptive learning by moving beyond outcome-based evaluations to emphasize the complex interplay between technological efficiency and human-centered educational experiences. The insights not only inform the design of adaptive systems that balance optimization with learner agency, identity, and well-being but also provide a methodological contribution by applying IPA to uncover nuanced perspectives in educational technology research.

INTRODUCTION

The rapid integration of artificial intelligence (AI) into higher education has transformed how students engage with knowledge, instructors, and peers in digital learning environments. Among the most notable developments are AI-based adaptive learning platforms, which personalize content delivery, adjust learning pathways, and provide real-time feedback tailored to individual learners' needs (Firmante, 2024; Keçeci & Ümmet, 2025). These platforms represent a significant shift from traditional teaching approaches by leveraging intelligent algorithms to dynamically modify instructional strategies based on learners' cognitive patterns, performance data, and behavioral responses.

In many academic contexts, this technological transformation is situated within broader sociocultural and educational dynamics. Students are increasingly expected to navigate complex, digitally mediated learning ecosystems where traditional face-to-face interactions are supplemented—or even replaced—by automated, data-driven recommendations (Khattib & Alt, 2024; Mitchell Dove, 2021). While adaptive learning technologies are designed to optimize learning efficiency, their integration into students' everyday educational experiences also raises important questions about autonomy, identity, and agency in learning.

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Despite growing enthusiasm for adaptive platforms, the subjective experiences of students using these technologies remain largely underexplored. Previous studies have predominantly focused on measurable learning outcomes, such as improved test scores and retention rates, often overlooking the personal meanings, emotional adaptations, and cognitive negotiations that accompany students' engagement with AI-driven systems (Cronin et al., 2023; Heineke et al., 2019). Yet, understanding these experiences is critical because learning is not merely a cognitive process but also a deeply personal and social phenomenon shaped by students' perceptions, motivations, and contextual realities.

Given this complexity, there is a pressing need to explore how students experience, interpret, and make sense of their interactions with AI-based adaptive learning platforms. A phenomenological approach offers a valuable framework for uncovering these lived experiences by prioritizing participants' voices and revealing the essential meanings underlying their engagement. Through this lens, the study seeks to provide insights that extend beyond technological efficiency, emphasizing the human dimensions of learning within digitally mediated environments.

Research on students' experiences within AI-based adaptive learning environments has increasingly gained attention in the field of educational technology. As higher education continues to adopt intelligent platforms to personalize instruction, scholars have begun to investigate how these systems shape learners' academic performance, motivation, and engagement (Abramowitz et al., 2025; Washburn et al., 2021). However, most existing studies remain anchored in quantitative paradigms, focusing primarily on statistical measures of achievement, system usability, or efficiency. While these findings provide valuable insights into performance trends, they fail to capture the complex, subjective meanings embedded within students' lived experiences.

Exploring these personal experiences presents significant methodological challenges. Quantitative approaches, by design, tend to reduce the richness of participants' realities into measurable variables, often neglecting emotional, cognitive, and social dimensions of learning (Miller, 2021; Stone et al., 2022). As a result, the nuanced ways in which students interpret, negotiate, and respond to algorithm-driven educational decisions are often overlooked. Furthermore, studies relying solely on surveys or structured questionnaires risk missing the depth of insight needed to understand how adaptive technologies influence students' identities, autonomy, and agency within learning environments.

These limitations highlight the need for a phenomenological approach, particularly one grounded in interpretative phenomenological analysis (IPA), to uncover the essence of students' experiences when interacting with AI-based adaptive learning platforms. Unlike experimental or correlational designs, phenomenology enables researchers to investigate participants' subjective interpretations, giving voice to their personal narratives and emotional journeys. By prioritizing meaning over measurement, this approach addresses a critical gap in current educational technology research and provides a deeper understanding of how students construct their realities in increasingly algorithm-mediated learning contexts.

Despite the growing body of research on AI-based adaptive learning platforms, much of the current understanding remains limited to practical and outcome-driven evaluations. Previous studies have primarily examined aspects such as system usability, learning efficiency, and academic performance metrics (Besche et al., 2022; Caldana et al., 2023). While these quantitative approaches provide insights into the effectiveness of adaptive learning systems, they fail to adequately capture the depth and complexity of students' personal and emotional engagement with these technologies.

The existing methodological focus on standardized surveys and statistical models reduces the richness of students' subjective realities to numerical outcomes, thereby overlooking critical dimensions of the learning experience, such as identity formation, emotional responses, and perceived autonomy (Cheng & Tsai, 2019; Fuller & Torres Rivera, 2021). As a result, current research offers only a fragmented understanding of how learners interpret and make meaning from their interactions with AI-driven systems.

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This limitation underscores the need for a phenomenological approach, particularly one grounded in interpretative phenomenological analysis (IPA), to investigate the lived experiences of students in adaptive learning contexts. By prioritizing participants' narratives and exploring their personal meaning-making processes, phenomenology allows for a more holistic and human-centered understanding of how adaptive technologies influence learners' identities, emotions, and agency. Addressing this gap is essential for developing educational systems that not only optimize learning performance but also respect and enhance students' subjective experiences within digitally mediated environments.

Recent studies have explored the role of AI-based adaptive learning platforms in shaping students' learning experiences. Existing literature highlights the potential of these systems to enhance personalization, motivation, and engagement. However, most studies remain limited to quantitative measurements, leaving the subjective meaning of students' lived experiences largely unexplored. The lack of focus on personal narratives creates a gap in understanding how learners interpret, negotiate, and emotionally respond to adaptive technologies. This study builds upon previous research by addressing this limitation and exploring the phenomenon through a phenomenological lens.

To address this gap, the study adopts an interpretative phenomenological analysis (IPA) to examine students' personal experiences with adaptive learning platforms (Cleary, 2022). This approach is chosen because it prioritizes participants' perspectives, allowing a deeper exploration of the meanings they assign to their learning journeys. Through in-depth interviews and thematic interpretation, the study seeks to answer critical questions raised earlier regarding identity, autonomy, and agency in technology-mediated education. The focus is not on measuring performance outcomes but on understanding the essence of lived experiences. By doing so, the study contributes a human-centered perspective to educational technology research.

The article is structured into several sections to provide a coherent narrative. The introduction presents the theoretical context and identifies gaps in existing literature. The methodology section explains the phenomenological approach, participant selection, data collection, and analytical procedures. The results section highlights emerging themes from students' experiences, supported by direct quotations to ensure authenticity. Finally, the discussion integrates these findings with existing theories, followed by a conclusion that underscores the implications for educational practice and future research.

RESEARCH METHODS

Study Design

This study employed an interpretative phenomenological approach (IPA) to explore the lived experiences of students using AI-based adaptive learning platforms (Fife, 2020; Kawamura, 2020). The phenomenological framework was chosen because it allows for an in-depth exploration of subjective meanings and personal realities as experienced by participants within their unique learning contexts (Mueller et al., 2024; Perry, 2023). Unlike descriptive phenomenology, which focuses on presenting the essence of experiences as they are, the interpretative approach acknowledges that meaning is co-constructed through participants' narratives and contextual interpretations.

IPA was considered the most appropriate design because it enables a detailed examination of how individuals make sense of their experiences and provides insights into the interplay between cognition, emotion, and social interaction in adaptive learning environments.

Participants

Participants consisted of twelve undergraduate students from a private university who had extensive experience using AI-based adaptive learning platforms for at least one academic semester (Hammersley, 2003; McMahon & McGannon, 2024). Purposive sampling was applied to ensure the selection of participants with relevant exposure and insights into the phenomenon being studied.

Inclusion criteria included:

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- Active enrollment in a higher education program,
- Regular use of AI-based adaptive learning platforms for at least 12 weeks, and
- Willingness to share personal learning experiences in depth.

Exclusion criteria involved students without prior experience using adaptive learning systems or those who had minimal engagement with digital learning platforms.

The sample consisted of 7 female and 5 male participants, aged between 19 and 24 years. This demographic representation provided a broad spectrum of perspectives while maintaining sufficient homogeneity to allow meaningful cross-case analysis within the interpretative phenomenological framework.

Data Collection

Data were collected through semi-structured, in-depth interviews designed to capture the richness and depth of participants' lived experiences (Bednarek-Gilland, 2015; Gibton, 2015). An interview protocol was developed based on the research objectives and refined through expert review to ensure conceptual clarity and alignment with phenomenological inquiry.

Interviews were conducted face-to-face in a private and comfortable setting within the university campus to foster an open and safe atmosphere. Each session lasted between 45 and 70 minutes and was audio-recorded with participants' consent to ensure data accuracy. Follow-up questions were employed to elicit deeper narratives and encourage reflection on personal experiences.

To complement the interviews, observational notes and platform interaction logs were examined to provide contextual validation and enrich the interpretation of student experiences.

Data Analysis

Data were analyzed using Interpretative Phenomenological Analysis (IPA), following a systematic and iterative process to identify patterns of meaning across participants' narratives (Lutz & Knox, 2014):

Transcription and Familiarization – Audio-recorded interviews were transcribed verbatim and read multiple times to develop a comprehensive understanding of participants' accounts.

Initial Coding and Meaning Units – Significant statements were identified and coded to capture essential experiential insights.

Theme Development – Codes were clustered into higher-order themes representing shared meanings and experiential patterns.

Cross-Case Analysis – Themes were compared across participants to identify both converging and diverging perspectives.

Synthesis of Essential Meanings – Thematic structures were integrated into a coherent narrative that reflects the essence of participants' lived experiences.

NVivo 14 software was utilized to organize transcripts, manage codes, and ensure analytical rigor, but the interpretation process remained researcher-driven to preserve the contextual richness of participants' narratives.

Ethical Considerations

Ethical approval for this study was obtained from the Research Ethics Committee of Borcsa & Rober, (2015). All participants received detailed information about the study objectives, procedures, and their rights before providing written informed consent.

Participants were assured of anonymity and confidentiality, and pseudonyms were used throughout the reporting process to protect personal identities. Data were stored securely and accessed

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only by authorized personnel in compliance with institutional guidelines and international ethical standards, including the Declaration of Helsinki.

RESULTS

Personalized Learning Journeys

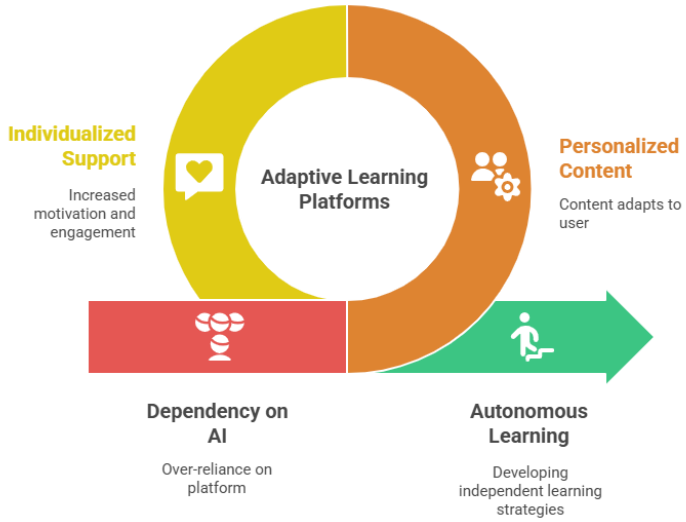
Participants consistently highlighted the transformative nature of AI-based adaptive platforms in shaping their learning trajectories. Most students described the platforms as "personal tutors" capable of recognizing their strengths, weaknesses, and preferred learning pace.

One participant explained:

"The system seems to understand me better than my lecturers sometimes. It adapts the content based on how I respond, and it feels like the lessons are designed just for me." — (P3)

For many, the sense of individualized support increased motivation and engagement. However, participants also reflected on the paradoxical challenge of dependency, as some began to rely heavily on the platform's recommendations rather than developing autonomous learning strategies.

AI-Powered Personalized Learning



Emotional Adaptation and Cognitive Challenges

Despite the benefits of personalization, students also encountered emotional and cognitive struggles when interacting with AI-driven platforms. Feelings of digital fatigue, performance anxiety, and overwhelming algorithmic control were common across participants.

"Sometimes I feel the platform pushes me too hard. It predicts what I need, but it also makes me anxious when I can't keep up with the pace it sets." — (P7)

Another student described the cognitive load required to manage multiple layers of digital feedback:

"It constantly analyzes my progress and gives me suggestions. While helpful, it can be mentally exhausting to process everything." — (P2)

These findings suggest that while adaptive technologies offer efficiency, they also introduce new forms of emotional labor and cognitive demands for learners.

Shifting Student–Technology Relationships

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An important insight from the data is the evolving relationship between students and educational technologies. Several participants described AI-based platforms as "partners" in their learning, while others expressed skepticism and distrust toward algorithmic decisions.

"It feels like the platform decides what I should know, but sometimes I wonder if it really understands what I need as a person." — (P5)

This ambivalence reflects a deeper negotiation of control and agency. Some students reported increased confidence in self-directed learning through AI guidance, whereas others felt constrained by the system's recommendations, perceiving a loss of human-centered interaction.

Negotiating Control and Autonomy in Learning

The final theme reveals how participants continuously negotiated between algorithmic authority and personal learning autonomy. While students appreciated data-driven insights, they also valued freedom of choice in deciding learning paths.

"The platform is very advanced, but I still want the flexibility to skip topics or explore things it doesn't recommend. Sometimes my curiosity doesn't match its predictions." — (P1)

This finding highlights the tension between technological efficiency and human agency, underscoring the importance of designing adaptive systems that balance personalization with learner independence.

Essential Synthesis

Across these themes, students' experiences with AI-based adaptive learning platforms are characterized by a dynamic interplay between personalized support and emotional adaptation, trust in technology and skepticism, efficiency and autonomy. The findings emphasize that while adaptive learning technologies offer significant benefits, they also introduce new psychological, cognitive, and ethical considerations that shape students' learning identities and agency.

These results provide a foundation for deeper theoretical discussions and practical implications, which will be elaborated in the Discussion section.

DISCUSSION

Contribution of Findings to the Research Question

The results provide valuable insights into how adaptive learning platforms influence students' perceptions of learning and self-agency (Mukhlis, Suradi, et al., 2023; Mukhlis, 2025b). By highlighting personalized learning journeys, the study demonstrates that students not only engage cognitively but also form affective and identity-based responses when interacting with AI-mediated systems. These findings answer the core research question by uncovering how students interpret their roles within algorithm-driven learning environments and the meanings they attach to these experiences.

Importantly, the findings reveal that students experience both empowerment and dependency when guided by adaptive technologies. While personalization fosters motivation and supports individualized growth, the sense of over-reliance on algorithmic recommendations introduces challenges related to self-directed learning. This nuanced understanding underscores the contribution of the study: rather than viewing adaptive learning solely as a technological tool, it highlights its human-centered implications on learners' identities, autonomy, and emotional well-being.

Relation to Previous Literature and Theoretical Perspectives

The findings align with previous research emphasizing the potential of adaptive learning platforms to enhance personalization and engagement (Mukhlis, Arifin, Ridwan, & Zulbaidah, 2025; Mukhlis, Arifin, Ridwan, Zulbaidah, et al., 2025). However, this study extends existing knowledge by uncovering the subjective dimensions of students' experiences, which have often been overlooked in prior quantitative-focused studies. Unlike earlier research that primarily measured usability and

performance metrics, this study reveals the emotional, cognitive, and social negotiations that occur when students interact with AI-driven systems.

From a theoretical standpoint, the findings resonate with constructivist learning frameworks, which posit that meaning emerges through learners' active engagement with knowledge, tools, and context (Mukhlis, Maryam, et al., 2023; Mukhlis et al., 2024). However, the presence of algorithmic mediation introduces a novel dimension not fully captured by traditional theories of learning. By combining phenomenological insights with educational technology literature, this study offers a more holistic understanding of how students perceive personalization, autonomy, and agency in digital learning contexts.

Furthermore, while earlier studies emphasized the benefits of adaptive systems for improving academic outcomes, the present findings reveal hidden tensions between technological efficiency and human-centered learning experiences. These results invite scholars to reconsider the balance between algorithmic decision-making and student autonomy, contributing a fresh perspective to ongoing debates in digital pedagogy.

Implications of the Findings

The findings of this study offer both scientific insights and practical implications for the integration of AI-based adaptive learning platforms in higher education (Mukhlis, Janwari, et al., 2023; Mukhlis & Abdullah, 2025). From a phenomenological perspective, the students' narratives reveal that personalization enhances engagement and fosters deeper connections with learning materials, but also introduces emotional and cognitive tensions when algorithmic recommendations challenge individual autonomy. These experiences underscore the need to design adaptive systems that balance technological efficiency with human agency, ensuring that personalization empowers rather than constrains learners.

Socially and culturally, the findings emphasize that adaptive learning cannot be viewed solely as a technological innovation but as a human-centered educational experience. Students' perceptions, emotional responses, and identity negotiations reflect the broader shift in educational ecosystems toward algorithm-mediated learning environments. For educators, these insights highlight the importance of pedagogical sensitivity when integrating AI-driven platforms into classrooms, encouraging the development of teaching strategies that complement rather than replace human interaction. At a broader level, the study contributes to ongoing debates on digital ethics, learner autonomy, and the implications of data-driven personalization for future educational policy.

Limitations of the Study

While the study provides rich and meaningful insights into students' lived experiences, several limitations should be acknowledged (Mukhlis, 2025a; Mukhlis & Saidah, 2025). First, the sample was limited to twelve undergraduate students from a single university, which restricts the transferability of findings to other contexts or educational systems. Second, the reliance on self-reported experiences through in-depth interviews may introduce subjective bias, as participants' accounts are shaped by memory, self-perception, and context-specific interpretations.

Additionally, the study adopted an interpretative phenomenological approach (IPA), which inherently prioritizes depth over breadth. As such, the findings are not intended to be generalized but to provide contextualized insights into students' meaning-making processes. Future studies could incorporate longitudinal designs, cross-institutional comparisons, or mixed-method approaches to examine how adaptive learning platforms shape experiences across diverse learning contexts and cultural settings.

Future Research Directions

Building upon these findings, future research could further investigate the complex interplay between personalization, autonomy, and identity in digitally mediated learning environments. One promising direction is to explore how different cultural and institutional contexts shape students' perceptions of algorithmic decision-making and adaptive feedback. Comparative studies across

countries or educational systems could reveal variations in how learners negotiate trust, agency, and engagement with AI-driven platforms.

Moreover, future work could integrate learning analytics with phenomenological inquiry to examine the relationship between behavioral data and subjective experiences, offering a more holistic understanding of adaptive learning processes. By combining narrative accounts with digital interaction patterns, researchers may uncover hidden dynamics that influence motivation, emotional regulation, and self-directed learning. These investigations would not only advance theoretical frameworks in educational technology but also inform the design of adaptive systems that are ethically responsible, culturally inclusive, and pedagogically sustainable.

CONCLUSION

This study explored students' lived experiences when engaging with AI-based adaptive learning platforms using an interpretative phenomenological approach. The findings reveal that adaptive technologies provide significant benefits by personalizing learning pathways, enhancing motivation, and supporting individual growth, yet they also introduce emotional tensions and challenges related to learner autonomy. By addressing these complexities, the study contributes to a deeper understanding of how students interpret, negotiate, and construct meaning within algorithm-mediated learning environments, filling a gap left by previous quantitative-focused research. These insights highlight the importance of designing adaptive systems that balance technological efficiency with human-centered learning needs. The results further encourage educators, developers, and policymakers to integrate adaptive technologies thoughtfully, ensuring that personalization supports agency rather than undermines it. Future studies are encouraged to investigate diverse educational contexts and combine phenomenological inquiry with learning analytics to develop more inclusive and ethically grounded adaptive learning designs.

CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the publication of this article.

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