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THE AI LEARNING PARADOX: REVEALING HOW UNIVERSITY STUDENTS NAVIGATE LEARNING CONVENIENCE, COGNITIVE EFFORT, DIGITAL CONTENT INFLUENCE, ACADEMIC CONFIDENCE, AND EDUCATIONAL ENGAGEMENT

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ABSTRACT

Artificial Intelligence (AI) has introduced a significant paradox in higher education by simultaneously enhancing learning accessibility, personalization, and academic confidence while creating concerns regarding reduced cognitive effort and technological dependency. This study explores how university students navigate AI-supported learning experiences by examining five key dimensions: learning convenience, cognitive effort, digital content influence, academic confidence, and educational engagement. Adopting a qualitative research design, the study investigates the lived experiences of 18 Pakistani university students through semi-structured interviews. Data were analyzed using reflexive thematic analysis to identify patterns within students' perceptions and practices of AI use. The findings reveal six major themes: AI as an educational accelerator, convenience versus intellectual struggle, confidence versus competence, transformation of digital learning consumption, risks of AI dependency, and purposeful AI-supported learning. The study demonstrates that AI can enhance educational engagement when used as a cognitive partner but may weaken independent learning when relied upon excessively. The findings highlight the importance of AI literacy, responsible technology integration, and pedagogical strategies that preserve students' cognitive autonomy while maximizing the benefits of AI in higher education.

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Introduction

Background of Research

Artificial Intelligence (AI) has become a significant transformative force in higher education by reshaping the ways students access information, interact with learning materials, and develop academic knowledge. Unlike traditional learning approaches that rely mainly on textbooks, classroom instruction, and fixed learning resources, AI-powered educational tools provide students with immediate explanations, personalized academic assistance, automated feedback, and adaptive learning opportunities. These developments have changed the nature of student learning from conventional information retrieval toward interactive knowledge construction, where learners can ask questions, receive customized explanations, and explore concepts according to their individual learning requirements. AI-supported learning environments have been shown to enhance students' self-directed learning capabilities by allowing greater control over learning processes and providing continuous academic support beyond classroom boundaries (Wu et al., 2024). Similarly, generative AI has expanded the possibilities of learning by supporting students in idea generation, problem-solving, reflection, and knowledge exploration, thereby influencing cognitive and metacognitive learning processes (Yan et al., 2025).

Despite these advantages, the integration of AI into higher education has created a complex educational paradox. While AI reduces the time and effort required to access information, it may also reduce the cognitive struggle that contributes to deeper understanding, analytical reasoning, and independent learning. The availability of instant AI-generated explanations, summaries, and solutions enables students to complete academic tasks more efficiently; however, excessive dependence on such tools may weaken students' motivation to critically analyze information and engage with challenging academic materials. This paradox extends beyond technological convenience and involves fundamental questions regarding cognition, metacognition, and students' epistemic agency—their ability to evaluate, question, and construct knowledge independently. Yan et al. (2025) highlighted that generative AI can simultaneously enhance learning efficiency and influence how students develop independent reasoning and reflective learning practices. Similarly, Wang and Zhang (2026) emphasized that AI-supported education operates through dual cognitive pathways, where AI can either promote transformative learning or encourage superficial engagement depending on the manner in which students utilize these technologies.

Furthermore, AI has transformed the relationship between students and digital learning environments by enabling personalized and interactive educational experiences. Students increasingly perceive AI tools as learning partners that can adapt explanations, examples, and feedback according to their academic needs and preferences (Novianti et al., 2026). Research also indicates that students' perceptions of AI influence their academic motivation, self-efficacy, and engagement, suggesting that AI adoption involves not only technological acceptance but also psychological and educational dimensions (Shi et al., 2026). Similarly, AI-driven learning environments have been associated with improved academic engagement by creating interactive

learning experiences and supporting continuous participation in educational activities (Ren et al., 2026). Within the broader transformation of digital education, AI represents both an opportunity for improving accessibility and personalization and a challenge requiring careful consideration of human learning processes, cognitive development, and responsible technology use (Thompson & Harris, 2025). Therefore, examining how university students navigate the balance between AI-enabled convenience, cognitive effort, academic confidence, and educational engagement is essential for understanding the future role of AI in higher education.

Problem Statement

The rapid adoption of artificial intelligence in higher education has generated extensive research on technology acceptance, AI adoption intentions, academic performance, and learning efficiency. However, comparatively limited attention has been given to the deeper educational paradox created by AI-supported learning, where technological convenience may simultaneously enhance and weaken student learning processes. Although AI tools provide immediate academic support and increase students' confidence in completing educational tasks, they may also reduce independent reasoning, analytical effort, and engagement with complex academic materials. Students may experience greater efficiency but weaker cognitive involvement, increased engagement with digital resources but reduced deep reading practices, and improved academic confidence without a corresponding increase in actual competence. Nazir and Yılmaz (2025) described this tension as the AI learning paradox, where educational benefits coexist with risks of digital dependency. Similarly, Jose et al. (2025) highlighted the cognitive contradiction between AI-driven learning enhancement and possible erosion of intellectual effort. Recent evidence further suggests that excessive reliance on AI may influence students' self-regulation and create a gap between perceived capability and genuine understanding (Galindo-Domínguez et al., 2026; Zhang & Xu, 2025). In emerging educational contexts, including Pakistan, these challenges require deeper investigation because AI adoption is increasing while institutional guidance regarding responsible use remains developing (Alhur et al., 2025). Therefore, this study explores how university students experience and negotiate the competing advantages and challenges associated with AI-supported learning.

Research Questions

RQ1: How do university students perceive AI's role in improving learning convenience?

RQ2: How does AI influence students' cognitive effort and independent thinking?

RQ3: How does digital educational content shape students' AI-supported learning behaviours?

RQ4: How does AI influence students' academic confidence?

RQ5: How does AI affect students' educational engagement and learning practices?

RQ6: How do students negotiate the balance between AI assistance and intellectual independence?

Research Objectives

1. To explore students' experiences of AI-supported learning convenience.
2. To examine how AI influences students' cognitive effort and independent thinking.
3. To investigate the role of digital content in shaping AI-mediated learning behaviours.
4. To understand the influence of AI on students' academic confidence.
5. To identify challenges associated with AI dependency and educational engagement.
6. To develop recommendations for responsible and meaningful AI integration in higher education.

Significance of the Study

This study contributes to the expanding field of artificial intelligence in education by examining AI as a complex educational phenomenon rather than merely a technological innovation. Existing research has primarily emphasized AI adoption, usability, and academic performance outcomes; however, this study focuses on the underlying paradox between technological convenience and cognitive development. By exploring students' lived experiences, the research provides insights into how AI influences learning behaviours, academic confidence, intellectual effort, and educational engagement.

The study is particularly significant within the context of Pakistani higher education, where digital transformation and AI adoption are rapidly progressing. Research examining educational technology strategies in Pakistan and other emerging contexts highlights the importance of developing institutional approaches that promote effective AI integration while addressing ethical, pedagogical, and digital literacy challenges (Khan et al., 2026). Understanding students' perspectives can help universities design AI literacy initiatives that encourage critical thinking, responsible technology use, and effective learning practices.

Furthermore, this research contributes to the human-centred AI perspective by emphasizing that AI should support rather than replace students' intellectual engagement. Previous studies have highlighted concerns regarding AI integration, including ethical challenges, trust issues, and the need for balanced classroom implementation (Rehmat et al., 2025). Similarly, digital technologies can produce unintended consequences when convenience becomes a substitute for meaningful cognitive engagement (França, 2026). Therefore, this study provides valuable theoretical and practical implications for educators, policymakers, and universities seeking to maximize the benefits of AI while preserving students' cognitive autonomy and deeper learning processes.

Literature Review

Theoretical Framework

The presents study is grounded in an integrated theoretical framework combining Cognitive Load Theory (CLT), Self-Regulated Learning (SRL) Theory, and the Technology Acceptance Model (TAM) to understand how university students navigate the benefits and challenges of AI-supported learning. Cognitive Load Theory, originally proposed by Sweller (1988) and further developed by Sweller et al. (2011), explains how learning effectiveness depends on the management of learners' cognitive resources. According to this perspective, learning improves when unnecessary mental demands (extraneous cognitive load) are reduced while maintaining the cognitive effort required for meaningful knowledge construction. Within AI-supported learning environments, artificial intelligence tools can reduce extraneous cognitive load by providing simplified explanations, immediate feedback, and structured information, enabling students to focus on essential learning processes. However, excessive reliance on AI-generated answers may also reduce desirable cognitive effort required for critical thinking, problem-solving, and knowledge retention (Meng et al., 2025). Recent research further suggests that AI-supported learning creates a cognitive paradox where reduced effort can enhance efficiency while simultaneously weakening deeper intellectual engagement and productive struggle (Ertan & Esfer, 2026).

The Self-Regulated Learning perspective, developed through the work of Zimmerman (2002), explains how learners actively manage their cognition, motivation, and behaviours through processes such as goal setting, self-monitoring, strategy selection, and self-evaluation. In AI-supported educational environments, students' learning outcomes depend not only on access to AI tools but also on their ability to regulate how these technologies are used. Students with strong self-regulatory abilities may employ AI as a strategic learning partner for reflection, feedback, and knowledge exploration, whereas students with weaker self-regulation may become dependent on automated assistance and reduce their independent engagement with learning tasks (Wu et al., 2024). Thus, SRL provides an important lens for explaining why the same AI technology may produce different learning consequences among students.

Finally, the Technology Acceptance Model (TAM) proposed by Davis (1989) explains technology adoption through two fundamental perceptions: perceived usefulness and perceived ease of use. Within AI-supported education, students are more likely to adopt AI tools when they perceive them as convenient, accessible, and effective for improving academic tasks. Recent evidence indicates that students' continued use of AI educational tools is strongly influenced by perceptions of usefulness, ease of interaction, and confidence in their ability to use these technologies effectively (Wan & Lu, 2026). Moreover, emerging research on agentic AI suggests that AI can enhance self-efficacy and autonomous learning when students maintain active control over AI interactions rather than becoming passive recipients of generated information (Algurni, 2026).

Therefore, the integration of Cognitive Load Theory, Self-Regulated Learning Theory, and Technology Acceptance Model provides a comprehensive theoretical foundation for explaining the AI learning paradox. This integrated framework suggests that AI influences student learning through three interconnected mechanisms: reducing cognitive barriers, shaping self-regulatory behaviours, and influencing technology adoption decisions. Together, these mechanisms explain how AI can simultaneously enhance learning convenience, academic confidence, and educational engagement while creating risks related to cognitive dependency and reduced intellectual autonomy.

AI as a Tool for Learning Convenience and Accessibility

Artificial intelligence has significantly enhanced accessibility in higher education by reducing barriers to academic support and enabling students to obtain immediate assistance regardless of time and location. Unlike traditional educational resources that may require physical availability of teachers, libraries, or institutional support systems, AI tools provide continuous access to explanations, examples, summaries, and problem-solving guidance. This accessibility is particularly valuable in educational contexts where students experience limited instructor availability or unequal access to academic resources. AI-powered educational assistants can provide individualized support by adapting explanations according to students' knowledge levels, learning preferences, and academic requirements (Chandiona, 2026).

The personalization capability of AI represents a major shift from standardized learning approaches toward learner-centred educational experiences. Students can interact with AI systems repeatedly, request alternative explanations, and receive customized examples that improve conceptual understanding. Novianti et al. (2026) highlighted that student-AI relationships increasingly involve personalization, where learners perceive AI as an adaptive academic companion rather than merely a technological tool. Similarly, AI-supported learning environments enhance flexibility by allowing students to regulate their own learning pace and access educational support outside formal classroom settings (Wan & Lu, 2026). However, the effectiveness of AI-based convenience depends on how students integrate these tools into their learning strategies. While AI can support knowledge construction and independent learning, excessive dependence may transform convenience into passive consumption of information. Therefore, AI accessibility should be understood as an opportunity that requires purposeful engagement and responsible learning practices (Yan et al., 2025).

The Cognitive Paradox: Convenience Versus Intellectual Effort

The integration of AI into education has created a fundamental tension between learning efficiency and cognitive engagement. AI tools reduce the effort required for searching information, understanding complex concepts, and completing academic tasks by providing instant explanations and synthesized knowledge. This reduction in cognitive burden can benefit students by allowing them to focus on higher-order learning activities. However, when students rely excessively on AI-generated answers, they may bypass the analytical processes, reflection, and problem-solving efforts necessary for developing independent intellectual abilities. Jose et al.

(2025) describe this phenomenon as the cognitive paradox of AI in education, where technological assistance simultaneously supports learning enhancement and creates risks of cognitive dependency.

From the perspective of Cognitive Load Theory, not all reduction in effort is beneficial. While reducing unnecessary cognitive demands can improve learning efficiency, eliminating productive struggle may negatively influence long-term knowledge development. Ertan and Esfer (2026) argue that difficult academic tasks often contribute to deeper understanding because students develop reasoning abilities through effortful engagement. Similarly, Nazir and Yılmaz (2025) suggest that AI creates a balance challenge where students must benefit from technological support without allowing convenience to replace intellectual effort. Research also indicates that AI dependency may produce a gap between perceived competence and actual learning capability, as students may feel confident after receiving AI assistance without fully understanding underlying concepts (Zhang & Xu, 2025). Galindo-Domínguez et al. (2026) further emphasize that excessive AI reliance can influence self-regulation by reducing students' willingness to independently engage with challenging academic activities. Therefore, the educational value of AI depends not only on accessibility but also on maintaining meaningful cognitive participation.

AI, Academic Confidence and Self-Efficacy Development

Academic confidence represents an important psychological outcome of AI-supported learning because students increasingly use AI tools to prepare assignments, clarify concepts, and receive immediate feedback. AI can strengthen students' self-efficacy by reducing uncertainty and providing continuous academic assistance. When students receive explanations, examples, and guidance from AI systems, they may feel more capable of addressing difficult academic tasks and participating actively in classroom discussions. Shi et al. (2026) found that students' perceptions of AI influence academic engagement through mechanisms involving motivation and academic self-efficacy.

However, AI-supported confidence may not always represent genuine competence. Students may develop a sense of mastery because AI helps them complete tasks quickly, even when their independent understanding remains limited. Zhang and Xu (2025) highlight the paradox between self-efficacy and technological dependence, suggesting that AI can increase students' confidence while simultaneously creating reliance on external support. This distinction is particularly important because academic success requires not only task completion but also the ability to apply knowledge independently.

The development of meaningful self-efficacy depends on how students interact with AI. When AI is used as a questioning partner, feedback mechanism, or learning assistant, it can encourage reflection and autonomous learning. In contrast, passive dependence on AI-generated answers may reduce students' ownership of the learning process. Alqurni (2026) argues that agentic AI environments can promote autonomy and self-learning motivation when students actively control AI interactions. Similarly, Wan and Lu (2026) emphasize that continued AI use in education depends on students' perceptions of usefulness combined with confidence in their own learning

capabilities. Thus, AI has the potential to strengthen academic confidence, but its educational value depends on whether confidence develops through genuine engagement or technological dependence.

Digital Content Influence and Changing Learning Behaviours

The expansion of digital educational content has significantly transformed how university students consume, process, and evaluate information. Students increasingly rely on AI-generated summaries, online tutorials, video-based explanations, and digital platforms as complementary sources of academic knowledge. These resources provide rapid access to simplified explanations and alternative perspectives, changing traditional learning patterns that were previously centred on textbooks and instructor-led teaching. Thompson and Harris (2025) argue that digital technologies have reshaped higher education by creating more flexible and interconnected learning environments.

However, digital learning environments also influence students' attention patterns and expectations regarding knowledge acquisition. Short-form educational videos and AI-generated summaries may encourage students to prioritize speed and convenience over comprehensive engagement with academic materials. França (2026) highlights that digital technologies represent a double-edged phenomenon because they improve personalization and accessibility while potentially encouraging fragmented learning behaviours. Similarly, Fitzgerald and Huijser (2026) emphasize that online learning environments require adaptive approaches because students increasingly navigate complex digital information ecosystems.

The influence of digital content is particularly relevant in understanding AI-supported learning because students often encounter AI within broader digital environments. Exposure to online platforms shapes perceptions regarding what information is considered valuable, how quickly knowledge should be acquired, and how much effort should be invested in academic tasks. Friyanda and Dartim (2025) describe this as a digital paradox where technology enhances educational opportunities but may also contribute to superficial learning patterns. Therefore, digital content consumption represents an important factor influencing students' engagement with AI and their expectations of modern learning experiences.

2.6 AI-Supported Educational Engagement and Responsible Learning

AI has the potential to transform students from passive recipients of information into active participants in knowledge construction. Through interactive questioning, personalized feedback, and adaptive explanations, AI tools can encourage students to explore concepts beyond traditional classroom limitations. Ren et al. (2026) suggest that AI-driven educational environments can enhance continuous engagement by creating interactive learning experiences that support motivation and academic participation. Similarly, Wang and Zhang (2026) argue that effective pedagogical partnerships with AI require students and educators to view AI as a collaborative cognitive tool rather than a replacement for human thinking.

Nevertheless, meaningful AI-supported engagement requires responsible use and adequate digital literacy. Students must develop the ability to evaluate AI-generated information, identify limitations, and integrate AI assistance with independent reasoning. Without these skills, AI use may encourage passive consumption rather than active learning. Research on AI integration in classrooms highlights ethical concerns related to dependency, accuracy, and the changing role of educators in technology-supported learning environments (Rehmat et al., 2025). Furthermore, human-centred explainable AI approaches emphasize the importance of trust, transparency, and user confidence when implementing AI systems among non-technical users (Rehmat et al., 2025).

Therefore, AI-supported educational engagement should not be measured only by increased usage or task completion. Instead, effective engagement should involve critical interaction, reflection, and intellectual ownership. Universities must promote learning environments where AI supports students' cognitive development while preserving human judgment and creativity.

Gaps in Existing Research

Although research on artificial intelligence in higher education has expanded rapidly, several important gaps remain. First, existing studies have largely focused on AI adoption, acceptance, and measurable learning outcomes, while fewer studies have examined students' lived experiences of navigating AI-related contradictions. Understanding how students personally experience convenience, dependency, confidence, and cognitive effort requires qualitative investigation beyond quantitative adoption models. Alhur et al. (2025) emphasized the importance of exploring AI dependency through qualitative inquiry because educators and learners experience complex tensions that cannot be fully captured through technological acceptance measures.

Second, limited research has examined AI-supported learning within Pakistani higher education contexts, where students encounter unique challenges related to digital infrastructure, educational resources, and institutional readiness. Third, existing literature provides insufficient understanding of the relationship between increased academic confidence and actual competence. While AI may improve students' confidence and task completion abilities, the extent to which it contributes to genuine learning remains uncertain (Galindo-Domínguez et al., 2026). Fourth, limited attention has been given to cognitive effort reduction as an educational consequence of AI use. Nazir and Yılmaz (2025) argue that the central challenge of AI-supported education lies in balancing convenience with meaningful intellectual engagement.

Finally, research has increasingly recognized the need to examine personalized student-AI interactions, but further exploration is required regarding how these relationships influence learning behaviours and academic identity (Novianti et al., 2026). Therefore, this study addresses these gaps by qualitatively investigating how university students negotiate the paradoxical effects of AI on learning convenience, cognitive effort, digital content influence, academic confidence, and educational engagement.

Methodology

Research Design

This study adopted a qualitative interpretive research design using reflexive thematic analysis to explore how university students experience and interpret artificial intelligence (AI)-supported learning practices. A qualitative approach was considered appropriate because the study aimed to understand students' perceptions, meanings, and experiences regarding AI use in academic contexts rather than measuring predefined variables or testing causal relationships. The interpretive orientation enabled the researchers to examine how students construct meaning around AI-supported learning, particularly in relation to learning convenience, cognitive effort, academic confidence, digital content influence, and educational engagement.

The study employed reflexive thematic analysis following the approach proposed by Braun et al. (2022), which provides a flexible and systematic method for identifying, analyzing, and interpreting meaningful patterns within qualitative data. Unlike approaches focused only on categorizing responses, reflexive thematic analysis recognizes the active role of researchers in interpreting participants' experiences and developing theoretically meaningful themes. This approach was particularly suitable for examining the complex and contradictory nature of AI-supported learning, where students simultaneously experience increased accessibility and confidence alongside concerns regarding dependency and reduced cognitive effort.

The analytical process involved systematic engagement with interview data through phases of familiarization, initial coding, generation of candidate themes, review and refinement of themes, and development of the final thematic structure (Braun et al., 2022). Previous methodological research highlights that reflexive thematic analysis is appropriate for exploring complex educational experiences because it allows researchers to capture both shared patterns and individual variations within participants' accounts (Byrne, 2022). Furthermore, attention was given to researcher reflexivity and analytical transparency throughout the process to enhance the credibility and trustworthiness of the findings (Hole, 2024).

Sampling Strategy

The study employed purposive sampling to select participants who had direct experience using AI tools for academic purposes. The sampling strategy aimed to achieve maximum variation by including students from diverse academic disciplines, genders, degree levels, and geographical locations across Pakistan. Such variation enabled the study to capture multiple perspectives regarding AI-supported learning experiences and identify common as well as contrasting patterns among students. Purposive sampling is particularly suitable for qualitative research where participants are selected based on their ability to provide rich and meaningful insights into the research phenomenon. Similar qualitative approaches have been used to explore educational and technological experiences by selecting participants with relevant lived experiences (Abrar & Amjad, 2026). Narrative-based qualitative research also highlights the importance of participant diversity in understanding complex social experiences (Ashraf et al., 2025).

Data Collection

Data were collected through semi-structured interviews conducted with 18 university students enrolled in different academic programs across Pakistan. Semi-structured interviews were selected because they provide flexibility for participants to describe their experiences while allowing researchers to explore specific dimensions relevant to the research objectives. The interview protocol focused on five major dimensions: learning convenience, cognitive effort, digital content influence, academic confidence, and educational engagement. Participants were encouraged to discuss their personal experiences, challenges, and perceptions regarding AI-supported learning practices. Semi-structured interviewing is widely recognized as an effective qualitative method for exploring individual meanings, perspectives, and experiences related to emerging educational phenomena (Braun et al., 2022).

Data Analysis

The collected interview data were analyzed using reflexive thematic analysis following the approach proposed by Braun et al. (2022). The analysis involved multiple stages, including familiarization with interview transcripts, generation of initial codes, development of potential themes, refinement of themes, and final reporting of findings. Thematic analysis was selected because it enables researchers to identify patterns across participants' experiences while maintaining sensitivity toward individual interpretations and contextual meanings. The analytical process involved continuous comparison between emerging themes and the research objectives to ensure conceptual consistency. Previous methodological research highlights that reflexive thematic analysis provides a rigorous framework for examining complex qualitative data while allowing interpretive depth (Byrne, 2022). Furthermore, careful consideration of researcher reflexivity and analytical transparency was maintained throughout the process, following recommendations for high-quality thematic research (Hole, 2024).

Ethical Considerations

Ethical principles were maintained throughout the research process to protect participants' rights, privacy, and autonomy. Before data collection, participants were informed about the purpose of the study, their voluntary participation rights, and their ability to withdraw from the research at any stage. Informed consent was obtained from all participants before conducting interviews. Confidentiality and anonymity were ensured by removing personally identifiable information and assigning participant codes during data analysis and reporting. The collected data were used exclusively for academic research purposes and stored securely to prevent unauthorized access. Ethical transparency and researcher reflexivity are essential components of qualitative research because they strengthen trustworthiness and protect participant experiences during interpretation (Hole, 2024).

Participants' Profile

The table below presents the demographic characteristics of the participants, including gender, age, degree level, academic discipline, and geographical location. The participants represented diverse educational backgrounds, including computer science, business, engineering, social

sciences, education, biotechnology, economics, and management sciences. This diversity enabled the study to capture varied perspectives regarding AI-supported learning experiences across different academic contexts.

Table 1: Participant Profiles

Participant	Gender	Age	Degree	Discipline	City
Participant 1	Male	21	BS	Computer Science	Islamabad
Participant 2	Female	22	BBA	Business Administration	Lahore
Participant 3	Male	23	MBA	Management Sciences	Rawalpindi
Participant 4	Female	20	BS	Psychology	Karachi
Participant 5	Male	24	BS	Engineering	Faisalabad
Participant 6	Female	21	BS	Media Studies	Islamabad
Participant 7	Male	22	BS	Economics	Multan
Participant 8	Female	23	MS	Management Sciences	Lahore
Participant 9	Male	20	BS	Business Administration	Peshawar
Participant 10	Female	22	BS	Education	Rawalpindi
Participant 11	Male	25	MS	Computer Science	Islamabad
Participant 12	Female	21	BS	Biotechnology	Karachi
Participant 13	Male	23	BS	Commerce	Gujranwala
Participant 14	Female	24	MBA	Business Administration	Islamabad
Participant 15	Male	21	BS	English	Sialkot
Participant 16	Female	20	BS	Accounting & Finance	Lahore
Participant 17	Male	24	MS	Public Administration	Peshawar
Participant 18	Female	22	BS	Sociology	Faisalabad

Findings and Discussion

Theme 1: AI as a Learning Accelerator and Source of Convenience

The findings indicate that students primarily perceive AI as a powerful learning accelerator that improves academic accessibility, reduces time constraints, and provides immediate academic assistance. Participants consistently described AI as a convenient learning partner that enables them to obtain explanations, examples, summaries, and problem-solving guidance without depending exclusively on traditional learning resources. The ability to ask repeated questions and receive personalized responses was viewed as particularly valuable because it allowed students to adjust explanations according to their individual understanding levels.

The findings demonstrate that AI has reduced traditional barriers associated with information searching and academic support. Students reported that AI helps them overcome difficulties in understanding complex concepts by providing simplified explanations and alternative examples. This personalized support reflects the increasing role of AI-based educational systems in creating adaptive learning environments where students receive assistance according to their specific needs (Chandiona, 2026). Similarly, Wan and Lu (2026) emphasize that perceived usefulness and accessibility are important factors influencing students' continued adoption of AI educational tools, particularly in contexts where academic resources and instructor availability may be limited.

However, the findings also suggest that convenience represents both an advantage and a potential challenge. Although AI enables faster access to knowledge, excessive emphasis on immediate solutions may influence students' willingness to independently explore academic problems. Therefore, AI functions as an effective learning accelerator when students use it to enhance understanding rather than replace personal engagement with learning tasks.

Theme 2: Convenience Versus Cognitive Effort Reduction

The findings reveal a central paradox in AI-supported learning: while AI reduces unnecessary effort, it may also reduce the productive struggle required for meaningful intellectual development. Students acknowledged that AI simplifies difficult concepts, provides instant summaries, and assists with complex academic tasks. However, this convenience sometimes decreases their motivation to engage deeply with textbooks, research articles, and challenging problems. The availability of immediate answers encourages some students to seek efficient solutions rather than develop independent analytical approaches.

This finding aligns with Ertan and Esfer (2026), who argue that AI-supported learning environments create a tension between reducing cognitive burden and preserving cognitive effort. While AI can minimize unnecessary mental workload by organizing information and simplifying explanations, excessive dependence may reduce desirable cognitive challenges that contribute to deeper understanding. Similarly, Jose et al. (2025) highlight that AI represents a cognitive paradox because it can simultaneously enhance educational experiences and weaken certain aspects of intellectual engagement.

The findings suggest that students' learning processes are shifting from effort-based exploration toward efficiency-oriented strategies. AI summaries and generated explanations often become the first point of interaction with academic content, potentially reducing students' willingness to struggle with complex ideas independently. However, cognitive effort remains essential for developing critical thinking, reasoning ability, and long-term knowledge retention. Therefore, the educational value of AI depends on maintaining a balance where technology supports learning without eliminating the intellectual processes necessary for academic growth.

Theme 3: Academic Confidence Versus Actual Competence

The findings demonstrate that AI significantly enhances students' academic confidence by providing immediate feedback, improving preparation, and reducing uncertainty regarding academic tasks. Students reported feeling more capable of participating in discussions, preparing assignments, and understanding difficult concepts because AI provides continuous academic support. This increased confidence represents an important psychological benefit of AI-supported learning, particularly for students who may hesitate to seek clarification in traditional classroom environments.

However, the findings also reveal a distinction between perceived competence and actual mastery. Some students recognized that AI-assisted completion of academic tasks could create a false sense of understanding. Completing assignments with AI support or receiving clear explanations does not necessarily guarantee the development of independent problem-solving ability. Zhang and Xu (2025) describe this phenomenon as the paradox between self-efficacy and technological dependence, where AI may increase students' confidence while simultaneously creating reliance on external assistance.

The findings support previous research indicating that AI perception influences academic engagement and self-efficacy. Shi et al. (2026) found that students' interactions with AI can strengthen motivation and academic confidence when AI is integrated effectively into learning processes. Nevertheless, confidence becomes educationally valuable only when supported by genuine understanding and independent application of knowledge. Therefore, AI should function as a mechanism for developing competence rather than merely increasing students' perception of capability.

Theme 4: Transformation of Digital Learning Consumption

The findings indicate that AI has contributed to a broader transformation in how students consume educational content. Students increasingly combine traditional academic resources with AI-generated summaries, online videos, digital platforms, and short-form educational materials. This shift reflects a movement from linear learning approaches toward flexible, multimodal digital learning practices. AI allows students to quickly transform complex information into simplified explanations, making academic content more accessible and engaging.

However, this transformation also influences students' attention patterns and expectations regarding learning speed. The preference for concise explanations and summarized information may reduce students' patience for lengthy academic readings and detailed theoretical discussions. França (2026) explains that digital technologies create a double-edged educational effect by improving personalization while potentially encouraging fragmented and superficial learning behaviours. Similarly, Thompson and Harris (2025) highlight that digital transformation has fundamentally altered higher education by changing how learners interact with knowledge.

The findings suggest that AI does not operate independently but exists within a wider digital ecosystem where students are continuously exposed to multiple sources of information. This environment influences what students consider valuable knowledge and how much effort they

expect to invest in learning. Therefore, digital learning transformation requires stronger digital literacy skills to help students critically evaluate information quality and maintain meaningful engagement with academic content.

Theme 5: AI Dependency and Responsible Learning Practices

The findings reveal that AI dependency represents one of the most significant challenges associated with AI-supported education. While students appreciate AI assistance, some acknowledged tendencies toward copying generated responses, relying on summaries, and accepting AI explanations without sufficient verification. These behaviours indicate that convenience can sometimes shift AI usage from supportive learning toward passive information consumption.

Participants who used AI effectively demonstrated greater awareness of verification practices. They compared AI-generated information with textbooks, academic articles, or instructor guidance before accepting responses. This suggests that responsible AI use requires students to develop evaluative skills rather than simply technical familiarity with AI tools. Alhur et al. (2025) identified AI dependency as a critical concern in higher education, emphasizing that excessive reliance can influence educators' and learners' autonomy.

Similarly, Galindo-Domínguez et al. (2026) found that AI overreliance can affect self-regulation by reducing students' independent engagement with academic tasks. The findings therefore highlight the importance of AI literacy as a necessary educational competence. Students need to understand both the capabilities and limitations of AI systems, including potential inaccuracies, oversimplifications, and biases. Responsible AI practices require a balanced approach where students use AI for assistance, reflection, and exploration while maintaining ownership of their intellectual work.

Theme 6: AI as a Partner for Active Educational Engagement

The findings indicate that AI can enhance educational engagement when students interact with it as a learning partner rather than an answer-generation tool. Students who used AI for brainstorming, questioning, generating examples, and exploring alternative perspectives reported more meaningful learning experiences. In such cases, AI encouraged active participation by allowing students to investigate concepts, challenge ideas, and personalize their learning processes.

This finding supports Wang and Zhang (2026), who argue that productive human-AI partnerships require students to engage with AI through dual cognitive pathways involving both technological assistance and human reasoning. When students critically interact with AI outputs, the technology can stimulate deeper reflection and transformative learning. Similarly, Ren et al. (2026) demonstrate that AI-driven educational environments can enhance continuous engagement by supporting interactive and personalized learning experiences.

However, the findings also reveal that engagement outcomes depend strongly on students' approach toward AI. Passive usage, such as requesting complete assignments without reflection,

may reduce learning involvement. In contrast, active questioning and evaluation can strengthen academic engagement. Therefore, AI should be conceptualized as a collaborative learning partner that extends students' cognitive abilities rather than replacing their intellectual contribution.

Synthesis of Findings

The findings demonstrate that AI-supported learning represents a complex educational paradox characterized by simultaneous benefits and challenges. On one hand, AI improves accessibility, reduces learning barriers, enhances academic confidence, and creates personalized learning opportunities. On the other hand, excessive reliance on AI may reduce cognitive effort, weaken independent reasoning, and encourage superficial engagement with academic content.

The central pattern emerging from the findings is that AI outcomes depend less on the technology itself and more on how students integrate AI into their learning practices. Purposeful AI use, characterized by questioning, verification, and reflection, enhances engagement and supports deeper understanding. Conversely, passive dependency may increase efficiency while reducing opportunities for intellectual development. Nazir and Yılmaz (2025) describe this tension as the AI learning paradox, where educational benefits coexist with risks of dependency and reduced autonomy.

These findings also support Yan et al. (2025), who argue that AI influences not only learning efficiency but also cognition, metacognition, and epistemic agency. Therefore, effective AI integration requires a balanced approach where students benefit from technological convenience while maintaining active cognitive participation. AI should support human learning processes rather than replace the intellectual struggle necessary for meaningful education.

Table 2: Thematic Analysis of Students' AI-Supported Learning Experiences

Themes	Sub-Themes	Initial Codes / Meaning Units	Interpretation of the Theme
Theme 1: AI as an Educational Accelerator	**Instant academic support**	Immediate explanations; Quick problem-solving; On-demand assistance	Students experience AI as a readily available academic support system that reduces barriers to accessing knowledge.
	Personalized learning assistance	Simplified explanations; Customized examples; Multiple explanations of concepts	AI enables individualized learning experiences by adapting information according to students' perceived learning needs.
	Efficiency in academic tasks	Reduced searching time; Faster assignment preparation; Improved productivity	AI increases learning efficiency by reducing the time required for

			completing academic activities.
Theme 2: Convenience Versus Cognitive Effort	**Reduced productive struggle**	Avoiding difficult readings; Immediate answers; Less independent exploration	AI convenience may reduce the intellectual struggle that contributes to deeper understanding and analytical development.
	Dependence on AI-generated content	Copying responses; Overuse of summaries; Reliance on generated explanations	Excessive AI reliance may shift learning from active knowledge construction toward passive information consumption.
	Changing problem-solving behaviour	Asking AI before attempting solutions; Reduced persistence; Lower patience with complex tasks	AI alters students' approaches toward challenging academic problems by encouraging efficiency-oriented strategies.
Theme 3: Confidence–Competence Paradox	**Enhanced academic confidence**	Better preparation; Reduced uncertainty; Increased participation	AI strengthens students' self-belief by providing continuous academic support and feedback.
	Perceived competence versus actual understanding	False confidence; Difficulty explaining concepts independently; Limited knowledge retention	AI-supported achievement may create confidence that exceeds students' actual conceptual mastery.
	Verification-based confidence	Cross-checking information; Comparing sources; Independent confirmation	Genuine confidence develops when AI outputs are critically evaluated rather than automatically accepted.
Theme 4: Transformation of Digital Learning Practices	**AI-mediated content consumption**	AI summaries; Digital explanations; Automated learning materials	Students increasingly integrate AI-generated content into their academic learning routines.
	Influence of short-form digital content	YouTube tutorials; Social media learning; Preference for concise explanations	Digital platforms reshape students' expectations regarding learning speed, format, and accessibility.

	Changing attention patterns	Reduced tolerance for lengthy texts; Preference for simplified content; Selective reading	Digital learning environments influence how students engage with traditional academic materials.
Theme 5: AI Dependency and Responsible Use	**Uncritical AI reliance**	Accepting AI answers; Limited evaluation; Reduced independent thinking	Dependency emerges when students use AI as a substitute for reasoning rather than as a learning aid.
	AI literacy and verification practices	Fact checking; Comparing academic sources; Evaluating accuracy	Responsible AI use requires students to develop critical evaluation skills and technological awareness.
	Maintaining learner autonomy	Personal judgment; Independent writing; Human decision-making	Effective AI integration requires preserving students' ownership of learning processes.
Theme 6: AI as a Cognitive Learning Partner	**Interactive knowledge construction**	Asking follow-up questions; Exploring alternatives; Concept clarification	AI can enhance learning when students engage in active dialogue rather than passive consumption.
	Idea development and academic reflection	Brainstorming; Organizing arguments; Identifying gaps	Students use AI to support higher-order thinking and improve academic reasoning.
	Balanced human–AI collaboration	Combining AI with teachers, peers, and textbooks	Meaningful AI-supported learning emerges when technology complements rather than replaces human interaction.

Discussion

The findings contribute to the growing debate regarding the dual consequences of artificial intelligence in higher education. Consistent with Yan et al. (2025), the results demonstrate that AI influences not only academic efficiency but also students' cognitive processes, metacognitive awareness, and ability to independently construct knowledge. The study extends previous research by showing that students experience AI as both an empowering learning assistant and a potential source of dependency.

The findings support Wang and Zhang's (2026) argument that AI-supported education involves dual cognitive pathways. Students who use AI interactively through questioning and reflection experience enhanced engagement, whereas students who rely on AI-generated solutions may experience reduced cognitive involvement. Similarly, Galindo-Domínguez et al. (2026) highlight that AI overreliance can negatively influence self-regulation, which aligns with students' concerns regarding reduced independent effort.

The confidence-competence paradox identified in this study further supports Zhang and Xu (2025), who suggest that AI can increase perceived capability without guaranteeing genuine understanding. Although AI improves academic confidence and engagement, meaningful learning requires students to actively process and evaluate information. This finding is consistent with Shi et al. (2026), who emphasize the role of AI perceptions in shaping motivation and academic engagement.

From a cognitive perspective, the findings reinforce Meng et al. (2025), suggesting that AI can reduce unnecessary cognitive burden while requiring careful management to avoid eliminating productive learning effort. The results also support Wan and Lu (2026), who emphasize that successful AI adoption depends on perceived usefulness combined with responsible usage practices. Finally, the findings align with Alhur et al. (2025) and Nazir and Yılmaz (2025) by demonstrating that AI integration requires institutional guidance, AI literacy, and pedagogical strategies that balance convenience with intellectual development.

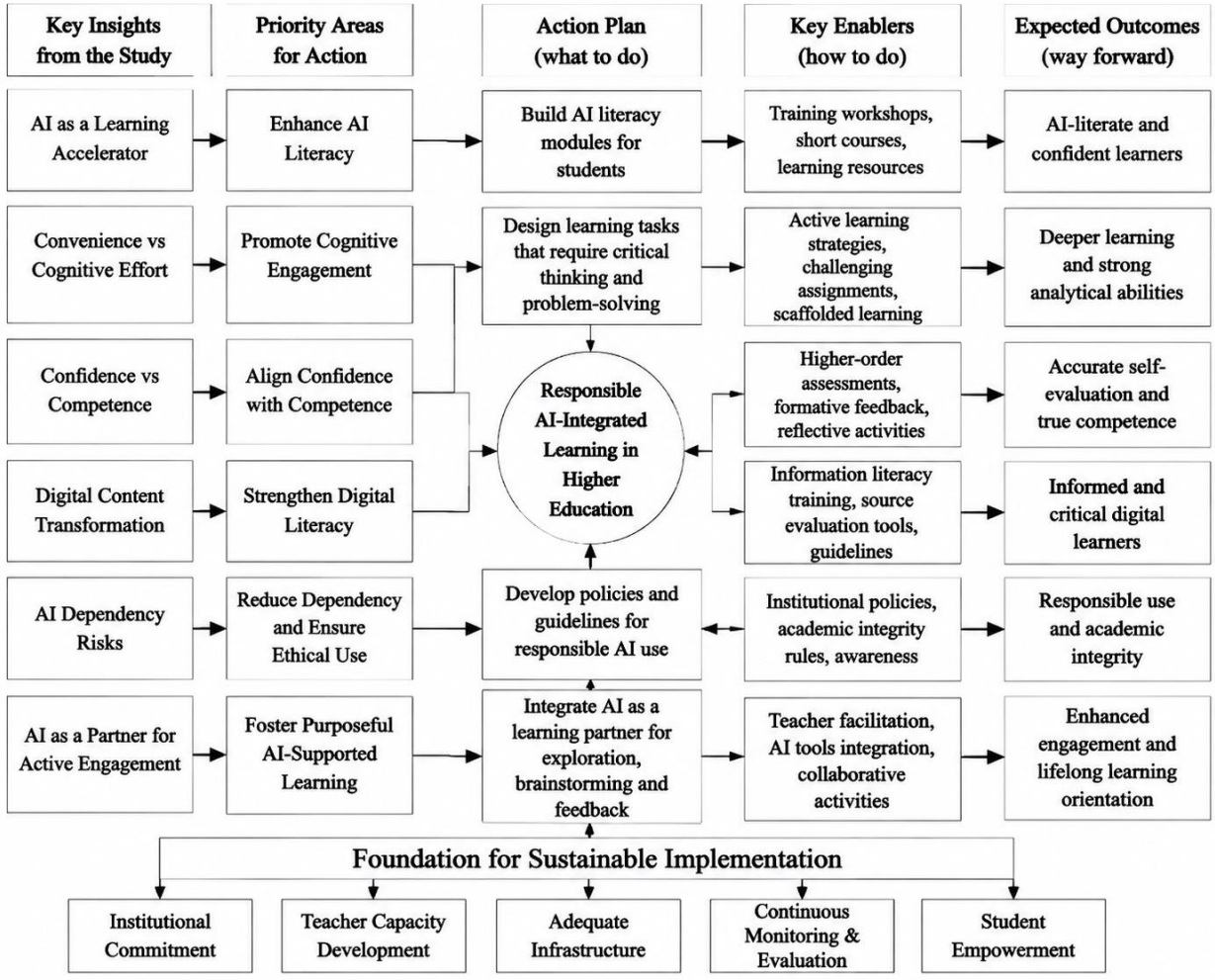


Figure 1. Proposed Framework Linking AI Learning Challenges, Strategic Priorities, Implementation Actions, and Expected Educational Outcomes

Conclusion, Implications and Future Directions

Conclusion

This study explored the AI learning paradox by examining how university students navigate the relationship between learning convenience, cognitive effort, digital content influence, academic confidence, and educational engagement. The findings demonstrate that artificial intelligence has fundamentally transformed student learning experiences by providing immediate access to information, personalized academic support, and interactive learning opportunities. Students perceive AI as a valuable educational assistant that improves accessibility, reduces learning barriers, and enhances confidence when dealing with complex academic tasks. AI-supported

learning environments allow students to obtain explanations according to their individual needs, experiment with different perspectives, and engage with academic content beyond traditional classroom limitations.

However, the findings also reveal that the benefits of AI are accompanied by significant challenges. Although AI improves efficiency and reduces unnecessary cognitive burden, excessive dependence on AI-generated explanations and summaries may reduce the cognitive effort required for deeper understanding. The central paradox identified in this study is that AI makes learning easier while potentially reducing the productive struggle that contributes to critical thinking, analytical reasoning, and long-term knowledge development. Students may experience increased academic confidence and faster task completion, yet this confidence does not always correspond with independent competence.

The study further highlights that the educational value of AI depends largely on how students use these technologies. Purposeful AI engagement, including questioning, verification, brainstorming, and critical evaluation, can enhance learning outcomes and promote active educational engagement. In contrast, passive dependence on AI may encourage superficial learning behaviours and weaken students' intellectual autonomy. Therefore, AI should not be viewed simply as a replacement for traditional learning practices but as a complementary tool that supports human cognitive abilities.

The findings emphasize the importance of responsible AI literacy in higher education. Universities need to prepare students not only to operate AI tools but also to critically evaluate AI-generated information, understand limitations, and integrate AI into meaningful learning processes. A balanced approach is required where technological convenience is combined with cognitive engagement, ensuring that AI strengthens rather than diminishes students' capacity for independent learning and knowledge creation.

Theoretical Implications

This study contributes to educational technology literature by extending Cognitive Load Theory into the context of AI-supported learning. The findings demonstrate that AI can reduce unnecessary cognitive demands while simultaneously creating risks of reducing meaningful intellectual effort. This supports the argument that cognitive efficiency and cognitive engagement must be balanced within AI-enhanced educational environments (Ertan & Esfer, 2026; Meng et al., 2025).

Furthermore, the study advances understanding of the confidence-competence paradox by demonstrating that AI may increase students' perceived academic capability without always developing equivalent independent skills. The findings contribute a qualitative perspective on AI dependency by explaining how students negotiate between technological assistance and personal intellectual responsibility. The study also supports the importance of self-regulated learning perspectives, suggesting that AI becomes educationally beneficial when students maintain control over learning decisions and actively manage AI interactions (Algurni, 2026; Wu et al., 2024).

Practical Recommendations

Based on the findings, universities should develop comprehensive AI literacy programs that educate students about effective, ethical, and responsible AI use. Such programs should focus not only on technical skills but also on critical evaluation, verification practices, and maintaining intellectual ownership of academic work.

Assessment practices should also be redesigned to emphasize reasoning, interpretation, creativity, and problem-solving rather than simple information reproduction. This approach can reduce inappropriate dependence on AI-generated responses and encourage deeper learning. Teachers should integrate AI as a learning partner by designing activities where students use AI for exploration, feedback, and reflection while maintaining independent judgment.

Students should be encouraged to verify AI-generated information through textbooks, academic literature, and expert sources. Institutional AI guidelines should promote cognitive engagement by emphasizing that AI should support learning processes rather than replace students' analytical efforts. Through responsible implementation, AI can become a tool for enhancing educational quality while preserving human intellectual development.

Limitations and Future Research Directions

This study has several limitations that should be considered when interpreting the findings. First, the qualitative design involved a relatively small sample of 18 university students, which limits the generalizability of findings across broader student populations. Second, the study focused specifically on Pakistani higher education contexts; therefore, cultural, institutional, and technological differences may influence the applicability of findings in other countries. Third, the research relied on participants' self-reported experiences, which may not fully represent actual AI usage behaviours.

Future research should extend this investigation through mixed-method approaches combining qualitative insights with quantitative measurement of AI usage patterns, academic outcomes, and cognitive effects. Cross-country comparative studies could provide deeper understanding of how cultural and institutional contexts influence AI-supported learning experiences. Additionally, longitudinal research is needed to examine how continuous AI exposure influences students' cognitive abilities, self-regulation, dependency patterns, and academic development over time. Such approaches would further clarify the evolving relationship between students and AI technologies in higher education (Novianti et al., 2026; Galindo-Domínguez et al., 2026).

References

Abrar, K., & Amjad, S. I. (2026). Gamified Advertising in the Metaverse: How Pakistani Brands Can Leverage Virtual Experiences for Customer Engagement. Social Science Review Archives, 4(1), 6022-6041.

Alhur, A. A., Khlaif, Z. N., Hamamra, B., & Hussein, E. (2025). Paradox of AI in higher education: Qualitative inquiry into AI dependency among educators in Palestine. JMIR Medical Education, 11, e74947.

Alqurni, J. (2026). Exploring the role of agentic AI in fostering self-efficacy, autonomy support, and self-learning motivation in higher education. Frontiers in Artificial Intelligence, 9, 1738774.

Ashraf, N., Arzu, F., Abrar, K., & Anwar, M. (2025). Narratives of SMEs on Access to Finance: Barriers and Opportunities in Pakistan's Banking Sector. The Critical Review of Social Sciences Studies, 3(4), 262-277.

Braun, V., Clarke, V., & Hayfield, N. (2022). 'A starting point for your journey, not a map': Nikki Hayfield in conversation with Virginia Braun and Victoria Clarke about thematic analysis. Qualitative research in psychology, 19(2), 424-445.

Byrne, D. (2022). A worked example of Braun and Clarke's approach to reflexive thematic analysis. Quality & quantity, 56(3), 1391-1412.

Chandiona, D. F. (2026). The Impact of AI-Powered Digital Assistants on Student Emotions, Engagement, and Academic Performance: A PLS-SEM Analysis in Higher Education. International Journal of Education and Management Engineering, 16(4), 106.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS quarterly, 319-340.

Ertan, S., & Esfer, S. (2026). Cognitive miser theory as a lens for rethinking cognitive effort during difficult and complex academic tasks in AI-supported self-regulated learning. Open Praxis, 18(3), 539-557.

Fitzgerald, R., & Huijser, H. (2026). Navigating the Impossible in Online Learning Design: Adaptive Solutions for Global Higher Education. Taylor & Francis.

França, M. V. (2026). Navigating paradoxes: the double-edged impact of digital technology on education. In Digital Tools and Platforms for Effective and Personalized Learning (pp. 27-58). IGI Global Scientific Publishing.

Friyanda, N. F., & Dartim, D. (2025). The Digital Paradox in Schools: Navigating The Intersection between Artificial Intelligence and Academic Performance. Proceeding ISETH (International Summit on Science, Technology, and Humanity), 632-643.

Galindo-Domínguez, H., Delgado, N., Sainz-de-la-Maza, M., & Etxabe, J. M. (2026). Self-regulation and overreliance on artificial intelligence: Unpacking a paradox through a mixed-methods study in higher education. Computers in Human Behavior, 108985.

Hole, L. (2024). Handle with care; considerations of Braun and Clarke's approach to thematic analysis. Qualitative research journal, 24(4), 371-383.

Jose, B., Cherian, J., Verghis, A. M., Varghise, S. M., S, M., & Joseph, S. (2025). The cognitive paradox of AI in education: between enhancement and erosion. Frontiers in psychology, 16, 1550621.

Khan, H. A., Mahmood, A., Bibi, K., Abrar, K., & Arif, S. N. (2026). A Vision for Digital Education: A Comparative Exploration of Government Strategies for ICT and AI Integration in Pakistan and Malaysia. Research Journal for Social Affairs, 4(3 (s5)), 205-214.

Meng, N., Mat Deli, M., & Abdul Rauf, U. A. (2025). Educational technology and AI: Bridging cognitive load and learner engagement for effective learning. Sage Open, 15(4), 21582440251395930.

Nazir, T., & Yılmaz, Z. E. (2025). The AI Learning Paradox: Balancing Educational Benefits and Digital Dependency. International Journal of Field Education, 11(3), 100-119.

Novianti, I., Krisnadi, E., Kandaga, T., Lince, R., Husnaeni, N., & Sudirman, S. (2026). Personalization Imperative: Unpacking Student-AI Relationships Through a Mixed-Methods Lens in Indonesian Higher Education. International Journal of Learning, Teaching and Educational Research, 25(1), 750-778.

Rehmat, M. A., Hassan, H., Khan, H. A., & Abrar, K. (2025). Artificial Intelligence in the Classroom: Teachers' Lived Experiences and Ethical Concerns in Educational Integration. ASSAJ, 4(02), 629-645.

Rehmat, M. A., Hassan, H., Rumaan, M., Baig, J., & Abrar, K. (2025). HUMAN-CENTRED EXPLAINABLE AI IN EMERGING MARKETS: TRUST AND CONFIDENCE AMONG NON-TECHNICAL USERS IN PAKISTAN. Annual Methodological Archive Research Review, 3(10), 145-163.

Ren, W., Zhao, J., & Liu, L. (2026). Unlocking Continuous Engagement in AI-Driven Education: An Integrated Model of Flow Experience, Academic Performance, and Technology Acceptance. Sage Open, 16(1), 21582440251415316.

Shi, Y., Cui, H., Zhang, Y., Hui, X., Li, G., Ouyang, M., & Pan, L. (2026). The impact of artificial intelligence perception on university students' academic engagement: the mediating role of academic motivation and the moderating role of academic self-efficacy. Frontiers in Psychology, 17, 1735410.

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. Cognitive science, 12(2), 257-285.

Sweller, J., Ayres, P., & Kalyuga, S. (2011). Altering element interactivity and intrinsic cognitive load. In Cognitive load theory (pp. 203-218). New York, NY: Springer New York.

Thompson, J., & Harris, O. (2025). A narrative review of educational technology in higher education. Social Science Chronicle, 5(1), 1-27.

Wan, Y., & Lu, K. (2026). When ease of use is not enough: self-efficacy and continued use of AI educational tools in resource-constrained universities. Frontiers in Psychology, 17, 1896153.

Wang, S., & Zhang, H. (2026). Pedagogical partnerships with generative AI in higher education: how dual cognitive pathways paradoxically enable transformative learning. International Journal of Educational Technology in Higher Education, 23(1), 11.

Wu, D., Zhang, S., Ma, Z., Yue, X. G., & Dong, R. K. (2024). Unlocking potential: Key factors shaping undergraduate self-directed learning in AI-enhanced educational environments. Systems, 12(9), 332.

Yan, L., Pammer-Schindler, V., Mills, C., Nguyen, A., & Gašević, D. (2025). Beyond efficiency: Empirical insights on generative AI's impact on cognition, metacognition and epistemic agency in learning. British Journal of Educational Technology, 56(5), 1675-1685.

Yan, L., Suleman Abdullah Alwabel, A., & Mohamad, U. H. (2025). AI-Powered Education: Transforming Teacher-Student Interactions and Advancing Sustainable Learning Practices. European Journal of Education, 60(4), e70351.

Zhang, L., & Xu, J. (2025). The paradox of self-efficacy and technological dependence: Unraveling generative AI's impact on university students' task completion. The Internet and Higher Education, 65, 100978.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. Theory into practice, 41(2), 64-70.