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Artificial Intelligence-Based Learning and Academic Achievement: A Systematic Literature Review of Self-Regulated Learning as a Central Mechanism

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ABSTRACT
The rapid adoption of artificial intelligence (AI) in education has created new opportunities for personalized learning, adaptive feedback, and academic support. However, existing findings remain fragmented, particularly regarding the mechanisms through which AI contributes to students' academic achievement. This study systematically synthesizes recent literature on AI-based learning and identifies the technological, psychological, behavioral, and contextual factors that influence academic achievement. A systematic literature review was conducted following the PRISMA 2020 guidelines. Literature was retrieved from the Scopus database on 8 June 2026. From 780 initial records, 59 studies met the eligibility criteria and were included in the final qualitative synthesis. Thematic analysis identified recurring patterns and conceptual relationships across the selected studies. Five main themes were identified: AI literacy and technological readiness, psychological factors, student engagement, self-regulated learning, and contextual and institutional factors. This review interprets self-regulated learning as a key explanatory mechanism in the proposed conceptual framework, based on thematic evidence related to feedback use, goal setting, monitoring, reflection, engagement, motivation, and strategic learning, rather than as an empirically tested mediator across most included studies. Key challenges included academic dishonesty, overdependence on AI, misinformation, cognitive overload, and ethical concerns. AI does not automatically improve academic achievement; rather, its contribution depends on how it supports students' motivation, engagement, and self-regulated learning within an enabling institutional context. The study proposes an integrated conceptual framework showing that AI literacy and technological readiness strengthen psychological factors, which enhance student engagement, promote self-regulated learning, and ultimately contribute to academic achievement.

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■ INTRODUCTION

The rapid development of artificial intelligence (AI) has transformed contemporary education through personalized learning, adaptive feedback, automated assessment, intelligent tutoring, learning analytics, and generative AI tools such as ChatGPT. These technologies can generate explanations, answer questions, support writing, provide examples, and help students complete academic tasks. In higher education, AI is increasingly viewed not only as a technological innovation but also as a pedagogical resource that may influence how students engage with learning materials, regulate their learning processes, and achieve academic outcomes. Previous studies indicate that AI-based learning tools can support engagement, motivation, confidence, and learning performance when they are integrated into meaningful pedagogical practices (Olaitan & Ajao, 2025; Yusof, 2025).

The urgency of this study arises from the growing use of AI in academic contexts and the continuing debate about its educational consequences. AI may improve academic achievement by providing immediate feedback, adaptive learning pathways, learning analytics, and individualized academic support (Hanshaw et al., 2025; Hong, 2025). However, the literature also reports risks such as academic misconduct, plagiarism, misinformation, overdependence, cognitive overload, and reduced critical thinking when students use AI mainly to obtain instant answers rather than to support reflective learning (Galindo-Domínguez et al., 2025; Sun et al., 2025). These contrasting findings show that the effect of AI on academic achievement cannot be explained by AI use frequency alone, but must be examined through the learning mechanisms and educational conditions that mediate its influence.

Current studies have examined AI in education from several perspectives, including technology acceptance, AI literacy, student engagement, self-efficacy, self-regulated learning, learning analytics, and academic integrity. Technology acceptance studies emphasize perceived usefulness, perceived ease of use, trust, and readiness (Marimon et al., 2025; Martha et al., 2025), while psychological studies highlight motivation, self-efficacy, satisfaction, and academic resilience as predictors of learning success (Almulla & Ali, 2024; Wen & Jin, 2026). Other studies indicate that AI is most beneficial when it promotes active participation, goal setting, monitoring, reflection, and strategic learning behavior rather than passive dependence on automated responses (Cacheda et al., 2024; Rakhmetov et al., 2025).

Despite this growing body of research, the literature remains fragmented. Many studies focus on a specific AI application, educational level, or isolated outcome such as engagement, motivation, performance, or prediction of academic risk (Diekuu et al., 2025; Santos & Berthet, 2026). Although these studies provide valuable evidence, they do not yet offer an integrated explanation of how AI contributes to academic achievement through technological, psychological, behavioral, and contextual pathways. The main problem is therefore the lack of a comprehensive synthesis that connects AI literacy, technological readiness, psychological factors, student engagement, self-regulated learning, and institutional support within a single conceptual framework. This gap is important because previous findings suggest that AI does not automatically improve academic achievement. Its contribution depends on whether AI functions as a learning support system that strengthens students' cognitive, motivational, and regulatory processes (Hanshaw et al., 2025; Triangga et al., 2026). Therefore, this study conducts a systematic literature review to synthesize recent evidence and develop an integrated conceptual framework for understanding the relationship between AI-based learning and academic achievement.

To sharpen the novelty claim, the proposed concept map and conceptual framework in Figure 5 can be distinguished from existing socio-technical models in educational technology, such as TPACK and SAMR. TPACK mainly explains effective technology integration through the alignment of technological, pedagogical, and content knowledge in teachers' instructional practice. At the same time, SAMR classifies how technology substitutes, augments, modifies, or redefines learning tasks. In contrast, this study's framework focuses on learner-level mechanisms that explain how AI-based learning contributes to academic achievement through a sequential process involving AI literacy, technological readiness, psychological factors, student engagement, self-regulated learning, and institutional support. Therefore, this framework does not merely describe whether technology is integrated or transformative; it explains why and under what educational conditions AI can support academic achievement, with self-regulated learning positioned as a theoretically synthesized explanatory mechanism rather than a direct empirical conclusion from all included studies. Accordingly, this study aims to systematically synthesize recent literature on AI-based learning and academic achievement and to identify the technological, psychological, behavioral, and contextual factors that explain this relationship. The main research question is: How does AI-based learning influence academic achievement, and what mechanisms explain this influence? More specifically, the study examines how AI literacy and technological readiness, psychological factors, student engagement, self-regulated learning, and institutional support interact in shaping academic outcomes.

The study is expected to contribute theoretically by organizing fragmented findings into a conceptual framework that explains AI-related academic achievement as a multidimensional process. Practically, the findings may help educators, institutions, and policymakers design AI-supported learning environments that promote engagement, self-regulated learning, ethical AI use, and academic achievement. The framework also provides a foundation for future empirical research in different educational contexts.

METHOD

This study employed a systematic literature review design to synthesize empirical evidence on the relationship between AI-based learning and academic achievement. The review followed the PRISMA 2020 framework to ensure transparency, consistency, and reproducibility in identifying, screening, selecting, and synthesizing relevant studies. This design was selected because the study did not collect primary data from human participants; instead, it systematically mapped and interpreted existing research findings on AI literacy, technological readiness, psychological factors, student engagement, self-regulated learning, contextual factors, and academic achievement.

Search Strategy

The literature search was conducted on 8 June 2026 using the Scopus database as the main source of bibliographic data. Scopus was selected because it provides broad coverage of peer-reviewed publications in education, social sciences, technology, psychology, and interdisciplinary research. The research was conducted as a desk-based review; therefore, the place of research refers to the digital database environment in which the literature search, screening, extraction, and synthesis were carried out.

The search strategy was constructed by combining terms related to artificial intelligence and learning outcomes. The Scopus search string was: TITLE-ABS-KEY ("artificial intelligence" OR "AI" OR "generative AI" OR "ChatGPT" OR "AI-based learning" OR "intelligent tutoring" OR "learning analytics") AND TITLE-ABS-KEY ("academic achievement" OR "academic performance" OR "learning outcomes" OR "student achievement" OR "student engagement" OR "self-regulated learning"). The search was then refined using Scopus filters for publication year, document type, subject area, language, publication stage, source type, and full-text availability to ensure that the selected records were relevant to educational research on AI-based learning and academic achievement.

The initial search identified 780 records. These records were refined through database filters and eligibility screening. The search process was documented to ensure that the review procedure was traceable and repeatable.

Inclusion and Exclusion Criteria

The data sources in this study were peer-reviewed journal articles indexed in Scopus. The target studies were empirical or conceptual studies that explicitly discussed artificial intelligence or AI-based learning in educational contexts and related it to academic achievement, learning outcomes, student engagement, self-regulated learning, or other relevant educational outcomes.

Table 1. Inclusion and exclusion criteria

Criterion	Inclusion Criteria	Exclusion Criteria
Publication year	Studies published between 2021 and 2026	Studies published before 2021
Language	Articles written in English	Articles written in languages other than English
Document type	Peer-reviewed journal articles	Conference papers, book chapters, editorials, notes, and non-peer-reviewed publications
Subject area	Social Sciences or closely related educational fields	Studies outside educational, pedagogical, psychological, or learning contexts
Access and publication stage	Final publications available in full text	Articles without full-text access or incomplete publication records
Topical relevance	Studies addressing AI-based learning, generative AI, ChatGPT, learning analytics, academic achievement, academic performance, learning outcomes, student engagement, or self-regulated learning	Studies focusing only on technical algorithm development without educational implications or studies not addressing learning outcomes

The sampling technique used in this review was purposive sampling based on predetermined inclusion and exclusion criteria, as summarized in Table 1. These criteria were applied consistently during title and abstract screening and full-text assessment to ensure that only studies directly relevant to AI-based learning and academic achievement were included in the final synthesis.

Study Selection and Quality Assessment

The research procedure consisted of four main stages. First, relevant literature was identified through a structured search in Scopus using keywords related to artificial intelligence and academic achievement. Second, records were screened using database filters and by reviewing titles and abstracts. Third, the full texts of potentially eligible studies were examined against the inclusion and exclusion criteria. Fourth, the studies that met all eligibility requirements were included in the qualitative synthesis. From 780 initial records, the screening process produced 220 potentially relevant articles. After full-text assessment, 78 articles were reviewed in detail, and 59 studies were finally included in the synthesis. The flow of identification, screening, eligibility assessment, and inclusion is presented in the PRISMA 2020 flow diagram in Figure 1.

To strengthen the credibility of the synthesis, a quality appraisal was conducted after the full-text assessment stage. Each potentially eligible study was reviewed based on five methodological and substantive criteria: clarity of research objectives, relevance to AI-based learning and academic achievement or learning outcomes, transparency of research

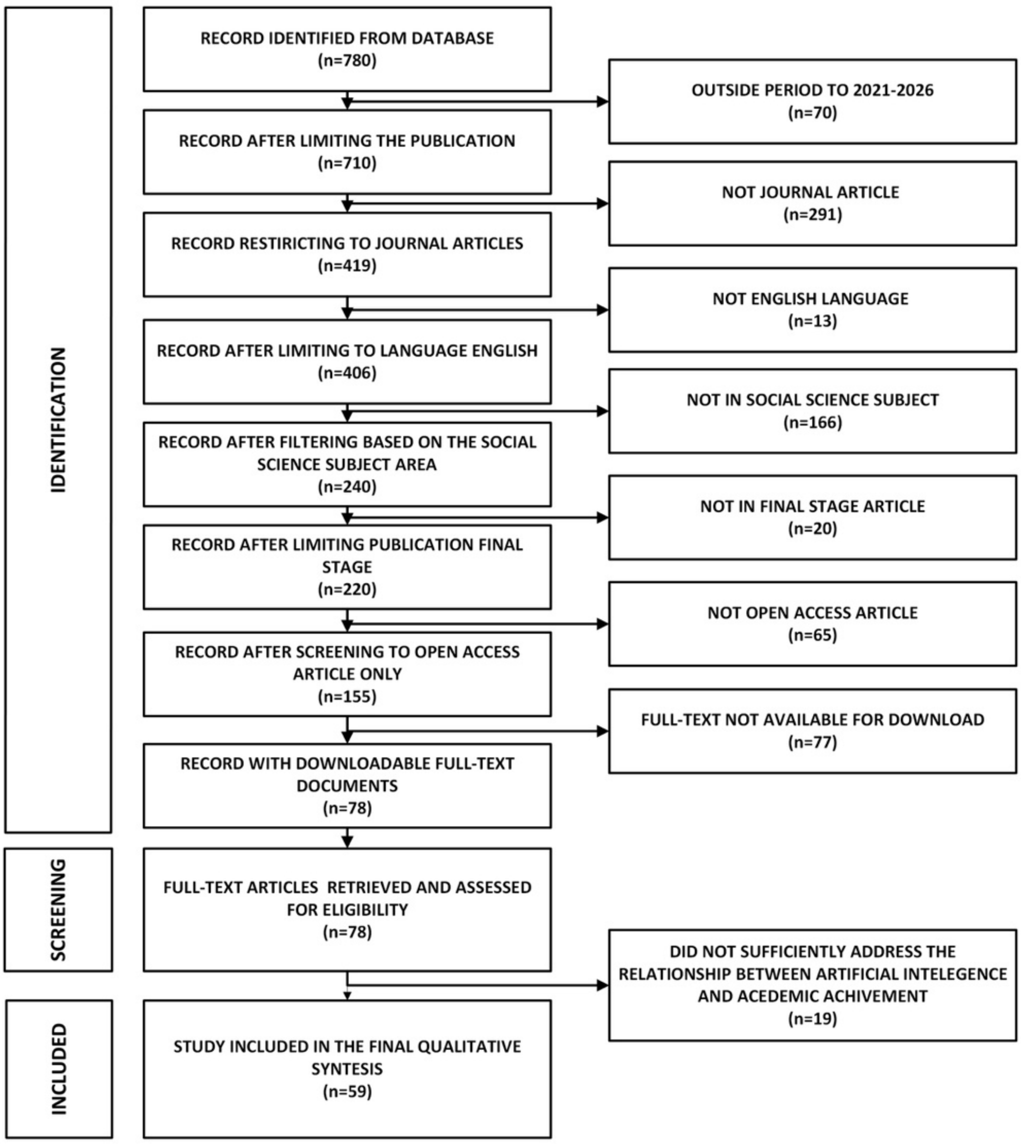

Figure 1. PRISMA 2020 diagram

design and data analysis, adequacy of reported findings, and contribution to the thematic synthesis. Studies were retained when they provided sufficient methodological information and clear evidence related to this review's focus. Studies with weak topical relevance, unclear methods, or insufficient connection to educational outcomes were excluded from the final synthesis.

To make the quality appraisal process more transparent and reproducible, this review used an author-developed appraisal rubric based on the five criteria described above. Each potentially eligible study was assessed using three decision categories: “yes” when the criterion was clearly met, “partly” when the criterion was partially met, and “no” when the criterion was not met. The appraisal was conducted independently by two reviewers after the full-text assessment stage. Any discrepancies in judgment were discussed until consensus was reached; when agreement could not be achieved, a third reviewer was consulted to make the final decision. The appraisal was not designed to generate a numerical quality score, but to determine whether each study had sufficient methodological clarity, topical relevance, and evidentiary value to be included in the qualitative synthesis. This approach was considered appropriate because the review included studies with diverse designs, including quantitative, qualitative, mixed-methods, conceptual, and review-based studies. Therefore, the appraisal results supported the interpretation of evidence and helped avoid overemphasizing studies with limited methodological clarity or only indirect relevance to academic achievement.

Data Extraction and Synthesis

The main instrument used in this review was a structured data extraction matrix. The matrix ensured that the same type of information was collected from each included study. The extracted information included author names, year of publication, educational context, research design, sample or participants reported in the original study, type of AI technology examined, variables or factors related to academic achievement, main findings, limitations, and implications. This instrument helped maintain consistency during data collection and supported cross-study comparisons.

Data were analyzed using qualitative thematic analysis. The analysis began by reading the selected studies repeatedly to identify concepts, variables, and findings related to AI-based learning and academic achievement. Similar concepts were then grouped into broader categories. These categories were compared across studies to identify recurring patterns, relationships, and mechanisms. The analysis focused on interpreting how AI contributes to academic achievement through technological, psychological, behavioral, and contextual pathways.

To improve the transparency and replicability of the thematic analysis, the synthesis followed the six-phase framework proposed by Braun and Clarke. First, the authors familiarized themselves with the included studies by reading each article repeatedly and recording preliminary notes on AI technologies, learning outcomes, psychological factors, engagement, self-regulated learning, and contextual conditions. Second, the authors generated initial codes inductively from the extracted findings, focusing on recurring concepts, variables, mechanisms, and reported effects related to AI-based learning and academic achievement. Third, similar codes were grouped into preliminary themes, such as AI literacy, technological readiness, psychological responses, student engagement, self-regulated learning, institutional support, and risks of AI use. Fourth, these preliminary themes were reviewed against the extraction matrix to ensure that each theme was internally coherent, supported by sufficient evidence, and clearly distinct from other themes. Fifth, the final themes were defined and named according to their explanatory role in the relationship between AI-based learning and academic achievement. Finally, the themes were synthesized narratively to develop an integrated conceptual framework explaining how technological, psychological, behavioral, regulatory, and contextual pathways connect AI-based learning with academic achievement. The coding and theme development process was discussed among the reviewers, and disagreements in theme classification were resolved through consensus to enhance interpretive reliability.

The thematic analysis produced five main themes: AI literacy and technological readiness, psychological factors, student engagement, self-regulated learning, and contextual and institutional factors. The analysis also identified challenges and negative consequences of AI-based learning, including academic dishonesty, overdependence on AI, misinformation, cognitive overload, and ethical concerns. These themes were then synthesized into an integrated conceptual framework that explains the relationship between AI-based learning and academic achievement.

■ RESULTS AND DISCUSSION

This systematic literature review presents descriptive results, supported by figures and tables summarizing the publication profile, study characteristics, thematic findings, and proposed conceptual framework. The analysis covered 59 eligible studies selected through the screening process. The findings show that the relationship between AI-based learning and academic achievement is multidimensional. AI does not consistently improve academic achievement as a direct technological effect; rather, its contribution depends on how AI supports students' technological readiness, psychological readiness, engagement, self-regulated learning, and institutional support.

Descriptive Profile of The Literature

The descriptive analysis indicates a rapid increase in publications on AI and academic achievement from 2021 to 2026. The number of publications rose from 3 documents in 2021 and 2 documents in 2022 to 8 documents in 2023, then increased sharply to 37 documents in 2024 and 75 documents in 2025. Although only 30 publications were identified in 2026 at the time of data collection, this number is likely to increase because the search was conducted in June 2026. This trend shows that AI-based learning, especially after the widespread use of generative AI such as ChatGPT, has become a major topic in educational technology research. The rapid growth of publications also reflects the urgency of understanding whether AI

Table 2. Synthesis matrix of included studies across the main themes

Study	AI literacy and technological readiness	Psychological factors	Student engagement	Self-regulated learning	Contextual / institutional factors and risks
(Dang & Nguyen, 2025; Martha et al., 2025; Qawqzeh & Mohammad, 2025; Tortella et al., 2025)	Strong evidence on perceived usefulness, readiness, AI literacy, trust, and attitudes toward AI use.	Shows links between confidence, perceived value, self-efficacy, and learning outcomes.	AI use is associated with greater participation when students perceive AI as useful and accessible.	Indirectly supports strategic AI use for feedback, practice, and monitoring.	Highlights the need for guidance, access, and critical AI literacy.
(Almulla & Ali, 2024; Marimon et al., 2025; Mohd Daud, 2026; Wen & Jin, 2026; Yang & Han, 2026)	AI readiness and trust appear as enabling conditions.	Strong evidence on motivation, self-efficacy, academic buoyancy, confidence, satisfaction, and emotional friction.	Psychological readiness increases willingness to engage with AI-supported learning.	Supports persistence, planning, and reflective use of feedback.	Negative emotional responses may weaken AI effectiveness.
(Hong, 2025; Kundu & Bej, 2025; Wilson-Trollip, 2025)	Technological affordances support interaction and access.	Perceived support, feedback, and confidence strengthen engagement.	Strong evidence on cognitive, emotional, and behavioral engagement.	Engagement supports monitoring, reflection, and sustained learning effort.	Effective when AI is embedded in meaningful pedagogical activities.
(Alhamadi, 2025; Borna et al., 2024; Nuankaew, 2022; Santos & Berthet, 2026)	Learning analytics and predictive systems depend on data readiness and AI infrastructure.	Feedback and early warning systems may improve confidence and persistence.	Intervention systems support engagement by identifying academic risk.	Strong evidence on monitoring, feedback use, progress tracking, and self-regulated learning.	Requires institutional data governance and pedagogical interpretation.
(Ibeh et al., 2025; Oates & Johnson, 2025; Shishakly & Nachouki, 2026)	Insufficient AI literacy increases misuse and uncritical dependence.	Overconfidence or low critical awareness may weaken learning quality.	AI may reduce meaningful engagement when used mainly for answer generation.	Risk of weakening independent monitoring, reflection, and strategy development.	Strong evidence on plagiarism, academic misconduct, misinformation, dependency, and ethical concerns.
(Ali et al., 2026; Mishu et al., 2025; Sharma & George, 2026)	Access to AI tools and teachers' and institutions' readiness shape implementation.	Teacher guidance and inclusive support influence students' confidence and acceptance.	Context-sensitive integration promotes active participation and learning satisfaction.	Pedagogical scaffolding supports reflective and strategic AI use.	Strong evidence on teacher support, institutional readiness, inclusive access, and policy guidance.

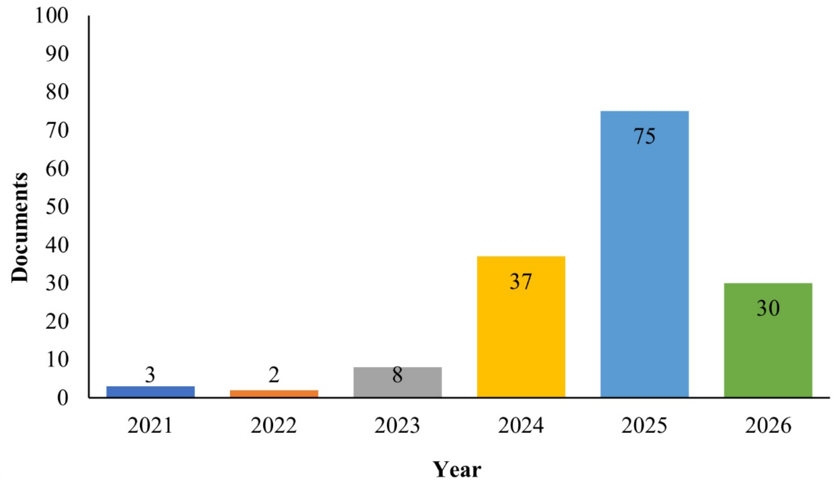

Figure 2. Publication trend

improves learning outcomes, under what conditions it works, and what risks accompany its implementation.

Main Publication Sources and Research Distribution

The selected literature was published in various international journals, indicating that the topic is interdisciplinary. The largest contributors were Computers and Education: Artificial Intelligence, Sustainability, Journal of Information Technology Education: Research, Frontiers in Education, and International Journal of Learning, Teaching and Educational Research. This distribution suggests that AI and academic achievement are discussed mainly within educational innovation, learning analytics, and technology-enhanced learning rather than only within technical computer science. The publication pattern also confirms that AI in education has moved from a technical issue to a pedagogical and institutional concern.

Geographical and Disciplinary Distribution

The geographical distribution shows that research on AI and academic achievement has developed globally. Saudi Arabia, China, the

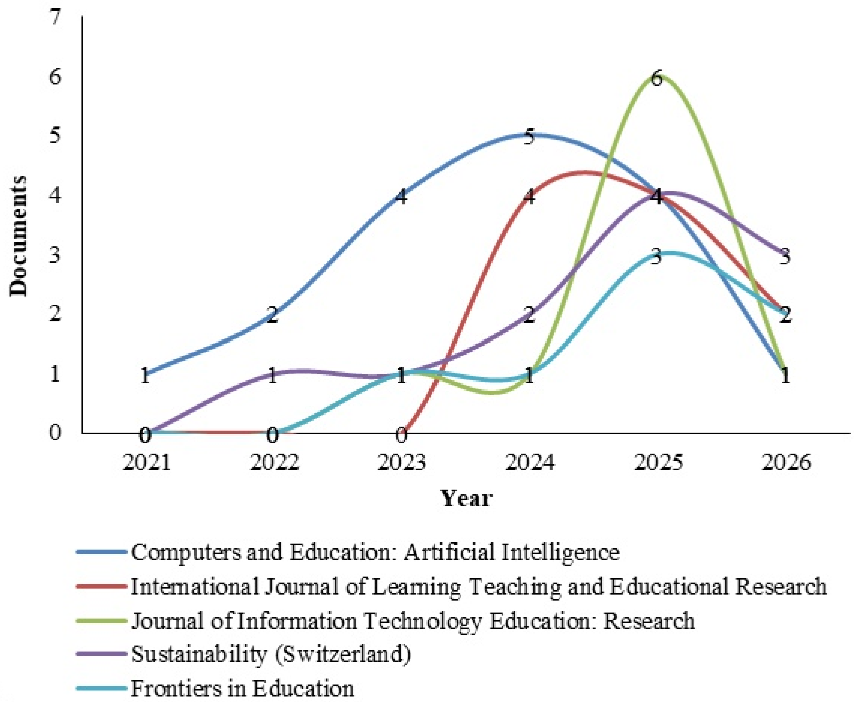

Figure 3. Publication sources

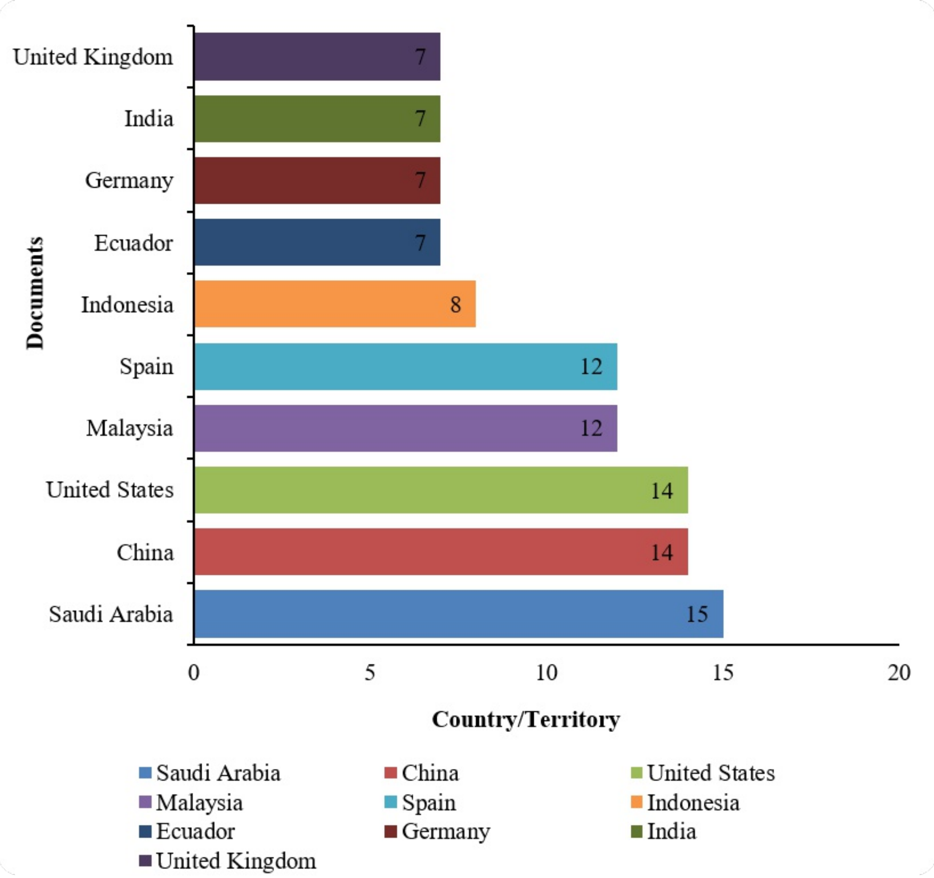

Figure 4. Geographical distribution

United States, Malaysia, and Spain were among the most productive countries, while Indonesia also appeared as an important contributor. This pattern indicates that AI-based learning is not limited to technologically advanced countries, but is also becoming relevant in developing educational systems. From the disciplinary perspective, Social Sciences represented the largest field, followed by Computer Science and Psychology. This confirms that the educational impact of AI must be understood through social, pedagogical, psychological, and technological lenses.

Subject Area, Institutional Contribution, and Author Productivity

The subject area distribution reinforces the educational orientation of the reviewed studies. Social Sciences dominated the search results, followed by Computer Science, Psychology, Environmental Science, Engineering, Business, and Health Professions. The institutional and author productivity data also show that no single institution or author dominated the field. This indicates that research on AI-based learning and academic achievement is still developing and is supported by diverse research communities. The absence of a single dominant research center suggests that conceptual integration is needed to organize scattered findings into a coherent explanatory framework.

Characteristics of The Included Studies

The final qualitative synthesis included 59 studies published between 2021 and 2026. These studies examined generative AI, ChatGPT, intelligent tutoring systems, AI-supported feedback, learning analytics, AI literacy, student engagement, motivation, self-efficacy, self-regulated learning, and academic achievement. Table 2 summarizes the main focus of the included studies and shows a shift from predictive analytics and early warning systems toward generative AI, personalized learning, engagement, and ethical use.

The included studies reveal four major patterns. First, AI-based learning can improve academic outcomes when students see AI as useful, accessible, and relevant to their learning needs (Olaitan & Ajao, 2025; Yusof, 2025). Second, AI contributes to academic achievement indirectly through self-efficacy, motivation, student engagement, and self-regulated learning (An & Ngo, 2025; Marimon et al., 2025; Rakhmetov et al., 2025). Third, predictive AI systems have been used to identify at-risk students and support data-driven intervention (Borna et al., 2024; Diekuu et al., 2025; Santos & Berthet, 2026). Fourth, the literature also documents risks such as plagiarism, academic misconduct, overdependence, misinformation, and cognitive overload (Galindo-Domínguez et al., 2025; Sun et al., 2025; Triangga et al., 2026).

Thematic Findings and Discussion

The thematic analysis identified five main themes: AI literacy and technological readiness, psychological factors, student engagement, self-regulated learning, and contextual and institutional factors. These themes answer the main research question by showing that AI-based learning influences academic achievement through a chain of interrelated mechanisms rather than through a single direct pathway.

The first finding is that AI literacy and technological readiness function as enabling conditions. Students who understand how AI works, recognize its limitations, and know how to evaluate AI-generated outputs are more likely to use AI productively and ethically (Dang & Nguyen, 2025; Martha et al., 2025; Tortella et al., 2025). This finding extends technology acceptance perspectives by showing that perceived usefulness and ease of use are not sufficient; students also need critical AI literacy to avoid passive dependence on automated answers.

The second finding concerns psychological factors. Self-efficacy, motivation, confidence, satisfaction, academic resilience, and positive attitudes toward AI were repeatedly linked to stronger learning engagement and outcomes. AI supports these psychological factors by providing immediate feedback, adaptive explanations, and individualized learning assistance (Almulla & Ali, 2024; De-La-peña et al., 2024; Kasimovskaya et al., 2025; Wen & Jin, 2026). This explains why AI may improve academic achievement in some contexts but not in others. When AI strengthens students' confidence and motivation, it can support deeper learning; however, when students experience anxiety, resistance, or emotional friction, AI may reduce learning quality (Mohd Daud, 2026). Therefore, psychological responses to AI are a key mechanism explaining variation in research findings.

The third finding shows that student engagement is a central behavioral pathway. AI-based learning environments can increase cognitive, emotional, and behavioral engagement by offering interactive explanations, personalized feedback, continuous support, and flexible access to learning resources. Studies on ChatGPT, AI course assistants, AI-supported reflection tools, peer-support systems, and AI-assisted microlearning consistently reported that engagement improves when AI is integrated into meaningful learning activities (Anwar et al., 2025; Hong, 2025; Salhab & Aboushi, 2026; Yu et al., 2025). This finding confirms that AI is most effective when it promotes active participation and critical interaction with learning materials. Conversely, AI may weaken engagement when students use it mainly to obtain instant answers without reflection or independent problem solving (Galindo-Domínguez et al., 2025; Sun et al., 2025).

The fourth finding suggests that self-regulated learning can be interpreted as an explanatory mechanism in the proposed conceptual framework, rather than as a claim that most included studies explicitly tested SRL as the main mediator between AI-based learning and academic achievement.

AI contributes to achievement by helping students set goals, plan learning activities, monitor progress, evaluate feedback, and adjust learning strategies. This finding is consistent with studies showing that AI-based feedback systems and adaptive learning tools enhance students' ability to regulate their own learning (Nuankaew, 2022; Putthidech et al., 2025; Rakhmetov et al., 2025). Theoretically, this interpretation suggests that academic achievement in AI-supported learning may be explained through students' active regulation of learning processes, although this pathway requires further empirical testing. AI becomes educationally valuable when it supports human agency, reflection, and strategic learning.

The fifth finding highlights the role of contextual and institutional factors. Institutional readiness, teacher support, infrastructure, policy, access, and the quality of the learning environment shape whether AI can produce positive academic outcomes. AI tools may be available, but their educational value depends on how institutions guide their use, how teachers integrate them into pedagogy, and whether students have equitable access to digital resources (Kundu & Bej, 2025; Moral & Moreno-Tallón, 2025; Sharma & George, 2026; Zhu et al., 2025). This finding indicates that AI implementation should not be treated as a purely technical issue. It requires institutional governance, ethical guidelines, teacher professional development, and inclusive digital infrastructure.

Table 3. Main themes explaining the relationship between AI-based learning and academic achievement

Theme	Representative Factors	Interpretation
AI literacy and technological readiness	AI literacy, readiness, trust, perceived usefulness, and perceived ease of use	Enables productive and critical use of AI in learning
Psychological factors	Self-efficacy, motivation, confidence, satisfaction, and academic resilience	Strengthens persistence, confidence, and willingness to learn
Student engagement	Cognitive, emotional, and behavioral engagement	Connects AI use with active learning participation
Self-regulated learning	Goal setting, planning, monitoring, reflection, and strategy adjustment	Serves as a theoretically synthesized explanatory mechanism linking AI-supported learning processes and academic achievement
Contextual and institutional factors	Teacher support, institutional readiness, infrastructure, policy, and access	Provides conditions that strengthen or weaken AI effectiveness

Synthesis of The Main Themes

Table 3 summarizes the main themes and shows that AI's effect on academic achievement is best explained as a process. AI literacy and readiness enable students to use AI effectively; psychological factors shape students' willingness and confidence to learn; engagement translates readiness into active participation; self-regulated learning is interpreted as an explanatory construct that organizes these processes into strategic learning behavior; and institutional support determines whether the learning environment strengthens or limits the process. This interpretation is based on the thematic synthesis of evidence related to feedback use, monitoring, reflection, goal setting, motivation, engagement, and strategy adjustment, not on the assumption that most included studies directly tested SRL as a mediator. This synthesis answers the "what" question by identifying the main findings, the "why" question by explaining the mechanisms behind those findings, and the "what else" question by showing their theoretical and practical implications.

Challenges and negative consequences

The review also found that AI-based learning poses risks when used without sufficient guidance. The most prominent risks are academic misconduct, plagiarism, overdependence on AI, misinformation, cognitive overload, ethical issues, and reduced critical thinking. Studies on generative AI misconduct, plagiarism, and academic integrity show that students may use AI to complete tasks without adequate authorship, verification, or reflection (Galindo-Domínguez et al., 2025; Shishakly & Nachouki, 2026; Torres-Diaz et al., 2025). Other studies warn that continuous dependence on ChatGPT may enhance short-term task completion but weaken independent learning if students rely on AI outputs without critical evaluation (Triangga et al., 2026). These findings contrast with studies that report positive learning effects and demonstrate that AI has a dual role: it can support academic achievement when used as a learning scaffold, but it can also undermine achievement when used as a substitute for learning effort.

The negative consequences are not inherent properties of AI itself. They emerge when students lack AI literacy, institutions do not provide clear ethical guidelines, assessment designs are vulnerable to misuse, or AI is used mainly for answer generation rather than reasoning support. Therefore, the discussion suggests that responsible AI integration requires three conditions: critical AI literacy, pedagogical guidance, and institutional governance. These conditions are necessary to ensure that AI supports reflection, problem solving, and self-regulated learning rather than passive dependence.

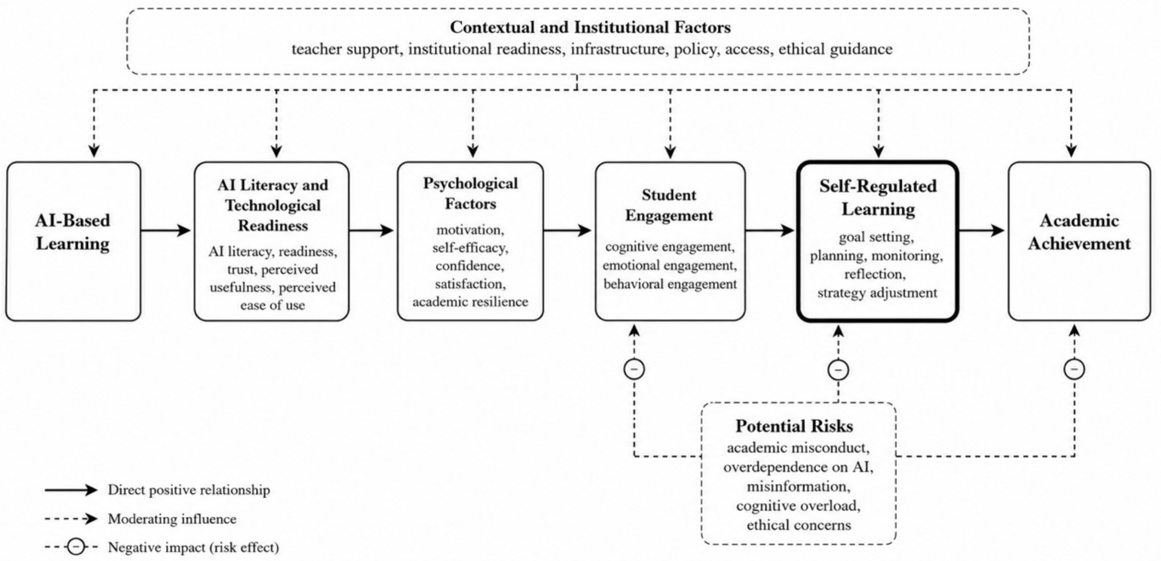

Figure 5. Concept map of interrelated mechanisms linking AI-based learning and academic achievement

Proposed conceptual framework

Based on the synthesis, this study proposes a conceptual framework in which AI literacy and technological readiness strengthen psychological factors; psychological factors increase student engagement; engagement promotes self-regulated learning; and self-regulated learning contributes to academic achievement. Institutional support operates across the entire process by enabling or constraining access, guidance, and responsible implementation. This framework should be understood as a theoretical synthesis derived from the reviewed literature, rather than as a confirmed causal model; it positions AI not as a direct determinant of academic achievement, but as a learning support condition whose effectiveness depends on learner-level and institutional mechanisms.

Implications

The findings have theoretical, practical, policy, and research implications. Theoretically, academic achievement in AI-supported learning should be understood as a multidimensional process rather than a direct technological outcome. AI-based learning becomes meaningful when it strengthens students' AI literacy, motivation, engagement, and self-regulated learning. Practically, educators can translate these findings into concrete AI-supported learning activities. First, AI-assisted retrieval practice can be designed by asking students to prompt an AI tool to generate practice questions on a topic, answer the questions independently, and then use AI-generated feedback to identify errors, revise misconceptions, and plan further study. Second, AI-supported reflective learning can be implemented by asking students to use prompts such as "What part of this topic do I understand well?", "What remains unclear?", and "What learning strategy should I try next?" to guide metacognitive reflection and self-regulated learning. Third, collaborative AI-supported discussion can be organized by assigning student groups to generate an initial AI response, evaluate its accuracy, bias, and limitations, compare it with course materials, and collaboratively produce a final answer with justification.

From a policy perspective, institutions should develop clear guidelines for ethical AI use, academic integrity, assessment redesign, data privacy, and equitable access to digital infrastructure. Such governance is needed to ensure that AI adoption supports originality, process-oriented assessment, critical thinking, and self-regulated learning. For future research, the proposed framework should be tested empirically using longitudinal, experimental, mixed-methods, or structural equation modeling designs across different educational levels, disciplines, cultural contexts, and AI technologies.

Limitations of the study

This study has several limitations to consider when interpreting the findings. First, the literature search was limited to the Scopus database. Although Scopus provides broad coverage of peer-reviewed publications, it may not include relevant studies indexed in other databases such as Web of Science, ERIC, ScienceDirect, or Google Scholar. Second, the review included only English-language journal articles published between 2021 and 2026. This criterion helped ensure recency and consistency, but it may have excluded relevant studies published in other languages, earlier periods, conference proceedings, book chapters, or institutional reports.

Third, this study used qualitative thematic synthesis rather than meta-analysis. Therefore, the findings explain patterns, mechanisms, and conceptual relationships, but they do not estimate the statistical effect size of AI-based learning on academic achievement. Fourth, the reviewed studies varied in educational level, country, discipline, research design, AI technology, and measurement of academic achievement. This diversity broadens the synthesis, but it also means the findings should be generalized with caution. Fifth, the number of publications identified for 2026 was partial because the search was conducted in June 2026, so the publication trend for that year may change as additional studies are published.

These limitations indicate that the proposed conceptual framework should be understood as a synthesized explanatory model rather than a definitive causal model. Future studies are encouraged to test the framework empirically using longitudinal, experimental, mixed-methods, or structural equation modeling approaches across different educational contexts.

■ CONCLUSION

This study concludes that AI-based learning influences academic achievement through an interrelated process involving technological readiness, psychological factors, student engagement, self-regulated learning, and institutional support. AI should not be understood as a direct determinant of academic achievement, but as a learning support condition that becomes meaningful when students use it critically, ethically, and strategically. The main research question is answered by showing that AI contributes to academic achievement primarily when it strengthens students' motivation, confidence, engagement, and capacity to regulate their own learning within a supportive educational environment.

This study's main contribution is an integrated conceptual framework that connects fragmented findings into a coherent explanation of AI-supported academic achievement. The framework positions AI literacy and technological readiness as enabling factors, psychological factors and engagement as mediating conditions, self-regulated learning as a theoretically synthesized explanatory mechanism, and contextual and institutional support as the environment that strengthens or limits the process. Future studies are encouraged to test this framework using longitudinal, experimental, mixed-methods, or structural equation modeling approaches in different educational settings to examine the strength of each pathway and support responsible AI integration for sustainable academic achievement.

■ REFERENCES

Alhamadi, A. A. (2025). Predicting the Academic Performance of the Students: Machine Learning Algorithms. *SN Computer Science*, *6*(8). https://doi.org/10.1007/s42979-025-04542-9

Ali, R., Mahmud, F. Al, AbdAlgane, M., & Elkot, M. A. (2026). Smart Virtual Assistant: Generating Pedagogical Activities to Enhance Perceived Self-Efficacy and Learning Performance. *Journal of Educational and Social Research*, *16*(3), 97–117. https://doi.org/10.36941/jesr-2026-0323

Almulla, M., & Ali, S. I. (2024). The Changing Educational Landscape for Sustainable Online Experiences: Implications of ChatGPT in Arab Students' Learning Experience. *International Journal of Learning, Teaching and Educational Research*, *23*(9), 285–306. https://doi.org/10.26803/ijlter.23.9.15

An, G. K., & Ngo, T. T. A. (2025). Unravelling Success In AI-Powered Personalized Learning In Vietnam: A Study On The Interplay Of Platform Features And Psychological Responses. *Journal of Information Technology Education: Research*, *24*. https://doi.org/10.28945/5668

Anwar, S., Butt, A. A., & Menekse, M. (2025). Utilizing an NLP-supported mobile reflection application to explore academic engagement, application engagement, and performance in engineering and physics courses. *International Journal of STEM Education*, *12*(1). https://doi.org/10.1186/s40594-025-00551-5

Bakhov, I., Bilous, N., Saiko, M., Isaienko, S., Hurinchuk, S., & Nozhovnik, O. (2024). Beyond the Dictionary: Redefining Translation Education with Artificial Intelligence-Assisted App Design and Training. *International Journal of Learning, Teaching and Educational Research*, *23*(4), 118–140. https://doi.org/10.26803/ijlter.23.4.7

Beltozar-Clemente, S., & Díaz-Vega, E. (2024). Physics XP: Integration of ChatGPT and Gamification to Improve Academic

Performance and Motivation in Physics 1 Course. *International Journal of Engineering Pedagogy*, *14*(6), 82–92. https://doi.org/10.3991/ijep.v14i6.47127

Borna, M.-R., Saadat, H., Hojjati, A. T., & Akbari, E. (2024). Analyzing click data with AI: implications for student performance prediction and learning assessment. *Frontiers in Education*, *9*. https://doi.org/10.3389/feduc.2024.1421479

Cacheda, F., López-Vizcaíno, M. F., Fernández, D., & Carneiro, V. (2024). Data-Driven Early Academic Intervention: Harnessing AI for Students Achievement. *International Journal of Information and Education Technology*, *14*(10), 1328–1334. https://doi.org/10.18178/ijiet.2024.14.10.2163

Dang, H. A. T., & Nguyen, V. T. T. (2025). Linking AI Literacy, Self-Efficacy, Attitudes, and Achievement: A Mixed-Methods Study On The Moderating Role of AI Usage and Study Year. *Journal of Information Technology Education: Research*, *24*, 1–26. https://doi.org/10.28945/5689

De-La-peña, C., Roda-Segarra, J., & Chaves-Yuste, B. (2024). Improving English Foreign Language (EFL) Performance using Artificial Intelligence in Vocational Education and Training (VET). *Journal of Technical Education and Training*, *16*(1), 71–83. https://doi.org/10.30880/jtet.2024.16.01.006

Desai, S. P., Munshi, M. M., Hanji, S. V, & Pabba, C. (2025). Optimizing Class Timing: AI-Driven Group Engagement's Role In Academic Success. *Journal of Information Technology Education: Research*, *24*, 1–28. https://doi.org/10.28945/5460

Diekuu, J.-B., Mekala, M. S., Abonie, U. S., Isaacs, J., & Elyan, E. (2025). Predicting student next-term performance in degree programs using AI-based approach: a case study from Ghana. *Cogent Education*, *12*(1). https://doi.org/10.1080/2331186X.2025.2481000

Eltahir, M. E., & Babiker, F. M. E. (2024). The Influence of Artificial Intelligence Tools on Student Performance in e-Learning Environments: Case Study. *Electronic Journal of E-Learning*, *22*(9), 91–110. https://doi.org/10.34190/ejel.22.9.3639

Galindo-Domínguez, H., Campo, L., Delgado, N., & de la Maza, M. (2025). Relationship between the use of ChatGPT for academic purposes and plagiarism: the influence of student-related variables on cheating behavior. *Interactive Learning Environments*, *33*(6), 4047–4061. https://doi.org/10.1080/10494820.2025.2457351

Guevara-Reyes, R., Ortiz-Garcés, I., Andrade, R., Cox-Riquetti, F., & Villegas-Ch, W. (2025). Machine learning models for academic performance prediction: interpretability and application in educational decision-making. *Frontiers in Education*, *10*. https://doi.org/10.3389/feduc.2025.1632315

Hanshaw, G., Wicker, E., & Denlinger, K. (2025). An Experimental Study of the Effect of AI Course Assistants on Student Grade Outcomes. *Open Praxis*, *17*(2), 270–285. https://doi.org/10.55982/openpraxis.17.2.772

Hong, N. X. (2025). Exploring how ChatGPT adoption shapes student engagement, critical thinking, and academic achievement. *Journal of Advanced Pharmacy Education and Research*, *15*(4), 163–171. https://doi.org/10.51847/YnHaklc11U

Ibeh, L., Mutai, N. C., Popoola, O. M., Cuong, N. M., & Ejiofor, S. (2025). Exploring perspectives on ChatGPT integration in education: A student-centered study of benefits, concerns, and global implications for responsible AI integration. *Research in Learning Technology*, *33*. https://doi.org/10.25304/rlt.v33.3384

Jere, S., & Mpeta, M. (2025). Integrating generative artificial intelligence chatbots into chemistry teaching: Impact of affective factors on engagement and conceptual understanding. *Eurasia Journal of Mathematics, Science and Technology Education*, *21*(10). https://doi.org/10.29333/ejmste/17077

Kasimovskaya, N., Fomina, E., Morugina, O., Malkina, O., Zhukova, M., & Biryukova, T. (2025). The Influence of Education Using Artificial Intelligence Technologies on the Formation of Moral Behavior and Self-Efficacy in Medical Students. *International Journal of Information and Education Technology*, *15*(5), 965–975. https://doi.org/10.18178/ijiet.2025.15.5.2303

Kundu, A., & Bej, T. (2025). AI in School EFL Learning: A Systematic Review of Impact Pathways for Engagement, Achievement, and Satisfaction. *Journal of Language and Education*, *11*(4), 131–148. https://doi.org/10.17323/jle.2025.22083

Marimon, F., Arias-Valle, M. B., Coria-Augusto, C. J., & Larrea Arnau, C. M.

(2025). From optimism to trust: how ChatGPT is reshaping student confidence in AI-driven learning; [Del optimismo a la confianza: el impacto de ChatGPT en la confianza de los estudiantes en el aprendizaje asistido por IA]. *RIED-Revista Iberoamericana de Educación a Distancia*, *28*(2), 131–153. https://doi.org/10.5944/ried.28.2.43238

Martha, A. S. D., Widowati, S., & Rahayu, D. P. (2025). ASSESSING STUDENT READINESS AND PERCEPTIONS OF CHATGPT IN LEARNING: A CASE STUDY IN INDONESIAN HIGHER EDUCATION. *Journal of Information Technology Education: Research*, *24*. https://doi.org/10.28945/5599

Mishu, A., Ahamed, Md. M., Akan, Md. F., Abdul-Rab, S. D., Chowdhury, G., Ahmad, J., & Sultana, I. (2025). How AI Is Ushering in a New Era in ELT: Teachers' Perspectives. *Theory and Practice in Language Studies*, *15*(2), 592–605. https://doi.org/10.17507/tpls.1502.29

Mohd Daud, N. (2026). Resisting the machine: modeling emotional friction and academic decline in enforced AI learning environments. *Smart Learning Environments*, *13*(1). https://doi.org/10.1186/s40561-026-00435-3

Moral, S. V., & Moreno-Tallón, F. (2025). Artificial Intelligence And Inclusive Education: Technological Solutions For Accessible Teaching. A Systematic Review; [Intel·Ligència Artificial I Educació Inclusiva: Solucions Tecnològiques Per A L'ensenyament Accessible. Una Revisión Sistemática: [Inteligencia Artificial y Educación Inclusiva: soluciones tecnológicas para una enseñanza accesible]. Revisión Sistemática. *Digital Education Review*, *47*, 62–77. https://doi.org/10.1344/der.2025.47.62-77

Nuankaew, P. (2022). Self-Regulated Learning Model in Educational Data Mining. *International Journal of Emerging Technologies in Learning*, *17*(17), 4–27. https://doi.org/10.3991/ijet.v17i17.23623

Oates, A., & Johnson, D. (2025). ChatGPT in the Classroom: Evaluating its Role in Fostering Critical Evaluation Skills. *International Journal of Artificial Intelligence in Education*, *35*(4), 1793–1824. https://doi.org/10.1007/s40593-024-00452-8

Olaitan, O., & Ajao, I. O. (2025). Generative AI in Higher Education: Investigating How Perceived Usefulness and Usage Patterns Influence Student Engagement and Academic Performance. *International Journal of Learning, Teaching and Educational Research*, *24*(11), 682–710. https://doi.org/10.26803/ijlter.24.11.32

Putthidech, A., Bootwisas, N., Intarasat, U., Boonman, P., & Singchua, W. (2025). The influence of AI-based learning perceptions on learning outcomes in calculus: The mediating role of cognitive and emotional responses using a PLS-SEM approach. *Eurasia Journal of Mathematics, Science and Technology Education*, *21*(11). https://doi.org/10.29333/ejmste/17390

Qawqzeh, Y., & Mohammad, H. (2025). The Perspectives of Undergraduate Students on the Effects of Generative AI on Academic Achievement. *International Journal of Information and Education Technology*, *15*(12), 2631–2636. https://doi.org/10.18178/ijiet.2025.15.12.2459

Rakhmetov, M., Sadvakassova, A., Saltanova, G., Kuanbayeva, B., & Zhusupkalieva, G. (2025). Evaluation of an AI-Based Feedback System for Enhancing Self-Regulated Learning in Digital Education Platforms. *Electronic Journal of E-Learning*, *23*(4), 126–141. https://doi.org/10.34190/ejel.23.4.4150

Salhab, R., & Aboushi, M. M. (2026). Impact of AI-assisted microlearning on student engagement in an online environment in higher education. *Frontiers in Education*, *11*. https://doi.org/10.3389/feduc.2026.1766032

Santos, R. F., & Berthet, M. (2026). Predicting graduation and dropout rates among engineering students using AI techniques. *Discover Education*, *5*(1). https://doi.org/10.1007/s44217-025-01092-3

Sharma, V. K., & George, R. (2026). Teachers' Perceptions and Experiences of ChatGPT Integration in Language Learning and Academia: A Mixed-Method Study. *Arab World English Journal*, *7*(1), 103–115. https://doi.org/10.24093/awej/vol17no1.7

Shishakly, R., & Nachouki, M. (2026). Academic Integrity and Students' Ethical Use of ChatGPT in Higher Education. *Journal of Information Technology Education: Research*, *25*, 1–29. https://doi.org/10.28945/5730

Sun, R., Tang, M., Zhou, J., Loan, N. T. T., & Wang, C.-Y. (2025). The dark tetrad as associated factors in generative AI academic misconduct: insights beyond personal attribute variables. *Frontiers in Education*, *10*. https://doi.org/10.3389/feduc.2025.1551721

Torres-Diaz, J. C., Duart, J., Rivera, D., & Flandoli, A. B. (2025). Artificial intelligence and academic integrity: exploring plagiarism in Ecuadorian universities. *International Journal for Educational Integrity*, *21*(1). https://doi.org/10.1007/s40979-025-00209-3
Tortella, F., Palese, A., Turolla, A., Castellini, G., Pillastrini, P., Landuzzi, M. G., Cook, C., Galeoto, G., Giovannico, G., Rodeghiero, L., Gianola, S., & Rossettini, G. (2025). Knowledge and use, perceptions of benefits and limitations of artificial intelligence chatbots among Italian physiotherapy students: a cross-sectional national study. *BMC Medical Education*, *25*(1). https://doi.org/10.1186/s12909-025-07176-w
Triangga, B., Noermijati, N., Rohman, F., & Sumiati, S. (2026). Can’t stop, won’t stop: continuance ChatGPT usage—enhancing performance or creating dependency? *Discover Education*, *5*(1). https://doi.org/10.1007/s44217-026-01114-8
Wen, X., & Jin, D. (2026). AI-transforming EFL learning: investigating the interplay of academic buoyancy, motivation, performance, and AI readiness among Chinese college students. *Humanities and Social Sciences Communications*, *13*(1). https://doi.org/10.1057/s41599-026-06899-5
Wilson-Trollip, M. (2025). The effect of artificial intelligence as a peer-to-peer support tool on engagement, grades, and pass rates. *Perspectives in Education*, *43*(1), 239–266. https://doi.org/10.38140/pie.v43i1.8911
Yang, K., & Han, D. (2026). A study on the stimulation and guidance of intrinsic motivation among engineering college students in China. *Frontiers in Education*, *11*. https://doi.org/10.3389/feduc.2026.1733781
Yu, M., Liu, Z., Long, T., Li, D., Deng, L., Kong, X., & Sun, J. (2025). Exploring cognitive presence patterns in GenAI-integrated six-hat thinking technique scaffolded discussion: an epistemic network analysis. *International Journal of Educational Technology in Higher Education*, *22*(1). https://doi.org/10.1186/s41239-025-00545-x
Yusof, I. J. (2025). ChatGPT-Assisted Retrieval Practice And Exam Scores: Does It Work? *Journal of Information Technology Education: Research*, *24*. https://doi.org/10.28945/5474
Zhu, M., Izhar, N. A., & Xervaser, C. R. (2025). Educators’ Perspectives On Deepseek in ELT: A Qualitative Case Study Of Pedagogical Potentials and Pitfalls In Chinese Higher Education. *Journal of Information Technology Education: Research*, *24*, 1–27. https://doi.org/10.28945/5625