

UNDERSTANDING AI DEPENDENCY IN STUDENT LEARNING AND PRACTICAL STRATEGIES FOR SUSTAINABLE LEARNING

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ABSTRACT

Artificial intelligence (AI) has become a common tool in education because it helps students complete academic tasks more easily and quickly. However, excessive reliance on AI may reduce students' independent learning, critical thinking, and problem-solving skills. This study aims to examine how AI dependency affects students' learning processes, critical thinking, and problem-solving abilities. This study used a systematic literature review method based on the PRISMA framework. Relevant articles were collected from Google Scholar, ScienceDirect, Springer, ResearchGate, Frontiersin, and ERSJ using keywords related to AI dependency and its effects on student learning. From thirty articles initially identified, twenty-one articles were selected after the screening and eligibility processes, and nineteen articles were analyzed based on the research questions. The findings show that excessive AI dependency may reduce students' learning engagement, independent thinking, cognitive effort, and academic achievement. It may also weaken students' ability to analyze information, make decisions, and solve problems independently. However, AI can support learning outcomes and student engagement when used appropriately and with proper guidance. In conclusion, AI should be used as a learning support rather than a replacement for students' own thinking. Students and teachers should develop AI literacy and encourage responsible AI use to support independent and effective learning. Furthermore, students need to maintain active participation in learning activities and develop their own understanding instead of depending entirely on AI generated answers. Teachers also play an important role in guiding students to evaluate AI generated information critically and use technology responsibly. These efforts can help ensure that AI supports educational development while preserving students' independent learning abilities and critical thinking skills.

Keywords: AI Dependency, Student Learning, Critical Thinking, Problem-Solving Skills

INTRODUCTION

Artificial intelligence (AI) has become increasingly common in education, especially among university students. AI tools such as ChatGPT can help students search for information, generate ideas, summarize materials, and complete academic tasks (Tian & Zhang, 2025). However, frequent and excessive use of AI may lead students to depend on it instead of actively thinking and solving problems by themselves. AI dependency can be defined as "the behavioral preference whereby students prefer to use AI instead of their own reasoning, knowledge, and experience to resolve academic problems or perform academic tasks" (Ou et al., 2026, p. 6). Recent research has raised concerns that excessive AI dependence may be associated with lower critical thinking and reduced independent learning.

Previous studies have found that excessive reliance on AI can affect students' learning and thinking abilities. Tian and Zhang (2025) found that greater AI dependence was associated with lower levels of

critical thinking among university students. Hou et al. (2025) also examined students' reliance on generative AI in problem-solving and emphasized the importance of critical thinking in how students use AI. In addition, Dakhi et al (2025), found In the Indonesian context, a study of EFL students also reported that ChatGPT was useful for writing, vocabulary, and confidence, but frequent use could lead to behavioral and emotional dependency. However, the effects of excessive AI reliance on students' overall learning process and problem-solving skills still need further attention.

The purpose of this article is to examine how excessive reliance on artificial intelligence may affect students' learning processes, critical thinking, and problem-solving skills. Specifically, this article aims to explore the effects of AI dependency on students' learning experiences and their ability to think critically and solve problems independently. The article addresses the following research questions:

1. How does excessive reliance on artificial intelligence affect students' learning process?
2. In what ways can AI dependency affect students' critical thinking and problem-solving skills?

METHODS

Literature Search

This literature search for literature on the dependence on AI of students through Google Scholar, ScienceDirect, Springer, ResearchGate, Frontiersin, and ERSJ. We used search terms related to our research questions including "AI dependence", "Impact of artificial intelligence", "overdependence on artificial intelligence," "learning process of students", "critical thinking", and "problem-solving skills." We were interested in articles written from 2022 to 2025 focusing on the impact of AI on the learning process of students, their critical thinking, and problem-solving skills. Our search yielded 30 articles that were further prepared for the screening process.

Selection Criteria

The study was conducted using a systematic literature review process based on the PRISMA framework, which consists of four phases: Identification, Screening, Eligibility, and Inclusion.

First phase—Identification: The keywords used in the search were "AI dependency", "impact of artificial intelligence", "overdependence on artificial intelligence," "learning process of students", "critical thinking", and "problem-solving skills." These keywords were used to narrow down the search and obtain articles relevant to the field of artificial intelligence dependency in education. The search was conducted through Google Scholar, ScienceDirect, Springer, ResearchGate, Frontiersin, and ERSJ. The initial search resulted in a total of 30 articles.

Second phase—Screening: The articles collected from the keyword search underwent a screening process based on the established inclusion and exclusion criteria. Five articles were eliminated from the initial 30 articles, leaving 25 articles for further examination.

Third phase—Eligibility: The 25 articles from the previous phase were thoroughly examined to determine

their relevance to the present study. Duplicate and less relevant articles were removed. A further examination of the full texts was conducted to ensure that only studies that met the required criteria were included. Four articles were considered ineligible, resulting in a final selection of 21 articles for use in this study.

Fourth phase—Inclusion: The final data selected for analysis consisted of 21 articles. However, only 19 articles were examined based on Research Question 1 (RQ1) and Research Question 2 (RQ2). Based on these research questions, several analysis categories were established as evaluation criteria for extracting relevant information from each selected article.

The Selection Process is presented in Figure 1.

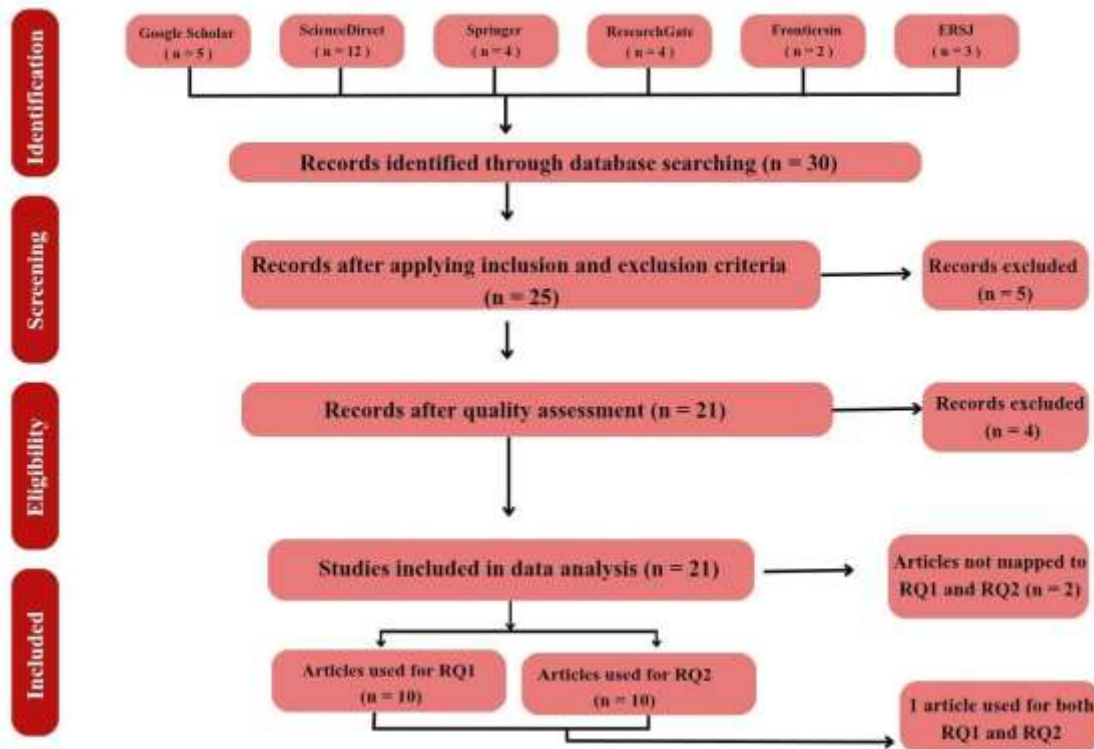


Figure 1. PRISMA-based literature selection process

The inclusion criteria were as follows: (1) the article was relevant to the research topic and research questions; (2) the article was written in English; (3) the article was published as a journal article; (4) the article was retrieved through Google Scholar, ScienceDirect, Springer, ResearchGate, Frontiersin, and ERSJ; (5) the full text was available; (6) the article discussed AI dependency in education; and (7) the article was published between 2022 and 2026.

Data Analysis



From the 19 articles that were chosen, information relevant to the research questions was identified. This included analysis of how an excessive dependence on artificial intelligence impacts the process of learning by the students and also how AI dependency influences students' ability to think critically and solve problems. The relevant information was extracted from the discussion and results sections of each article. From the results obtained from the chosen studies, similarities and differences among the studies were identified. Similar results were categorized into several themes, mainly focusing on the impact of AI dependency on the learning process, critical thinking, and problem solving of students.

RESULTS AND DISCUSSION

The principal findings will be presented objectively and systematically in accordance with PRISMA-based systematic literature review. Table 1 demonstrates the study's results.





No.	Author & Year	Research Focus	Context	Main Finding	Related RQ
[1]	Zhang et al. (2024)	AI dependency and problematic AI usage.	University students and academic activities.	Excessive AI use is associated with laziness, misinformation, reduced creativity, and lower independent thinking.	RQ 1
[2]	Jia et al. (2025)	GenAI dependency and academic achievement.	University students using GenAI for academic tasks.	Over-reliance on GenAI may encourage cognitive outsourcing and negatively affect students' academic achievement.	RQ 1
[3]	Adiyono et al. (2025)	Student reliance on AI for academic answers.	Students using AI for exams and academic tasks.	AI can help students complete tasks faster, but excessive use may reduce understanding and independent learning.	RQ 1
[4]	Zhang & Xu (2025)	GenAI use, technological dependence, and independent learning.	University students completing academic tasks with GenAI.	GenAI can improve task completion and self-efficacy, but excessive dependence may reduce independent learning.	RQ 1
[5]	Revesai (2025)	Generative AI dependency and academic performance.	University students and academic performance.	Higher AI dependency is	RQ 1





				associated with negative effects on students' learning and academic achievement.	
[6]	Lee et al. (2024)	Guided ChatGPT use and student learning.	Students using ChatGPT with a guided learning approach	Guided use of ChatGPT can support self-regulated learning, knowledge construction, and student engagement.	RQ 1
[7]	Lo et al. (2024)	ChatGPT and student engagement.	Students using ChatGPT in learning.	Overreliance on ChatGPT may reduce critical thinking and negatively affect students' engagement in learning.	RQ 1
[8]	Hou et al. (2025)	Students' reliance on GenAI during problem-solving.	Undergraduate students using GenAI for problem-solving.	Appropriate AI reliance can support learning, while overreliance may undermine students' problem-solving abilities.	RQ 1
[9]	Chen & Cheung (2025)	GenAI and university students' learning outcomes	University students using generative AI	GenAI can positively affect learning outcomes when it is used appropriately as a learning support.	RQ 1





[10]	Zhai et al (2024)	Over-reliance on dialogue systems and students' cognitive abilities	Students and educational use of AI dialogue systems	Over-reliance on AI may negatively affect students' critical thinking analytical thinking decision-making, and problem-solving	RQ 1 & 2
[11]	Adesokan et al. (2025)	AI usage and reliance among undergraduate students.	Undergraduate students in the Faculty of Education, Kwara State University, Nigeria.	Students showed considerable reliance on AI tools for academic activities, raising concerns about independent thinking.	RQ 2
[12]	Goh et al. (2025)	Generative AI dependency and its behavioral and psychological factors.	AI users from the United States and Singapore.	AI dependency is not only frequent AI use but also involves cognitive preoccupation, negative consequences, and withdrawal.	RQ 2





[13]	Szmyd & Mitera. (2024)	AI and students' critical thinking and problem-solving skills.	University students.	Students recognized that AI can support learning, but excessive reliance on AI may weaken independent thinking and decision-making.	RQ 2
[14]	Tian & Zhang (2025)	AI dependence and critical thinking.	580 Chinese university students.	Greater AI dependence was associated with lower critical thinking, with cognitive fatigue partly explaining this relationship.	RQ 2
[15]	Stadler et al. (2024)	LLM use, mental effort, and scientific inquiry.	University students.	LLM users experienced lower mental effort but showed weaker reasoning in their analyses.	RQ 2
[16]	Fan et al. (2024)	Generative AI, learning processes, and metacognitive laziness.	Students and AI-supported learning.	Generative AI can make learning easier, but passive use may encourage metacognitive laziness and reduce students' active learning processes.	RQ 2





[17]	Hou et al. (2025)	Critical thinking and reliance on Generative AI in problem-solving.	Undergraduate students in problem-solving activities.	Students show different AI reliance behaviors; thoughtless use involves accepting or copying AI-generated content with limited modification.	RQ 2
[18]	Morales-García et al. (2024)	Development of an AI-dependence scale.	University students.	The study developed a scale to measure students' dependence on AI, helping explain AI dependence as a measurable behavior.	RQ 2
[19]	Melisa et al. (2025)	AI or ChatGPT and critical thinking in higher education.	Higher education students across different academic disciplines.	AI can support critical thinking, analysis, and argument construction, but over-reliance can reduce self-reflection and critical evaluation.	RQ 2

Table 1. Literature Analysis Discussion



Findings for Research Question 1

Research Question 1 asks : How does excessive reliance on artificial intelligence affect students' learning process? Excessive reliance on artificial intelligence (AI) can influence the way students engage with and process learning materials. Zhang et al. (2024) found that over-reliance on AI can reduce students' cognitive engagement because students may prefer quick answers instead of processing information deeply. Similarly, Zhang and Xu (2025) found that although Generative AI can increase students' self-efficacy, technological dependence may reduce students' ability to learn independently. These findings suggest that when students rely too much on AI, they may become less actively involved in the learning process and less willing to work through problems independently. The negative effects of excessive AI reliance can also extend to students' academic development. Jia et al. (2025) found a negative relationship between GenAI dependency and academic achievement and explained that over-reliance may encourage "cognitive outsourcing," where students allow AI to perform some of the cognitive work for them. This is also supported by Revesai (2025), who found a clear decline in academic performance as AI dependency increased. In contrast, Lee et al. (2024) found that guided use of ChatGPT could improve students' self-regulated learning, knowledge construction, and engagement. This comparison shows that the way students use AI is important; AI does not necessarily have negative effects when it is used with appropriate guidance.

Furthermore, Lo et al. (2024) reported both engagement and disengagement in ChatGPT-supported learning. Their systematic review found evidence of cognitive engagement, such as increased understanding, but also cognitive disengagement, including reduced critical thinking and overreliance on AI. Chen and Cheung (2025) similarly found that Generative AI had a positive effect on university students' learning outcomes, including academic achievement and higher-order thinking. These findings indicate that AI can support learning when students use it appropriately rather than depend on it excessively. The importance of how students rely on AI is further demonstrated by Hou et al. (2025), who identified four forms of reliance: reflective, cautious, thoughtless, and collaborative use. This indicates that students' reliance on AI can take different forms, and not all forms of reliance have the same influence on learning. Adiyono et al. (2025) also found that students frequently used AI because of its convenience, although many students believed that AI helped them develop a deep understanding of the learning material.

Finally, Tian and Zhang (2025) reported that greater AI dependence was associated with lower critical thinking. Overall, these studies show that AI can provide useful support for students' learning, but excessive dependence may reduce cognitive engagement, independent learning, academic development, and critical thinking. Therefore, AI should be used as a learning support rather than as a replacement for students' own thinking and effort. Too much usage of artificial intelligence (AI) technology can have an impact on how students perceive and process the material in terms of their interaction with the content. According to Zhai et al. (2024), the excessive use of artificial intelligence can cause a decrease in students' cognitive engagement since they might favor quick solutions to information processing. In the same vein, Zhang and Xu (2025) found that while Generative AI can boost the self-efficacy of students, technological dependency can hinder their ability to study independently.

Findings for Research Question 2

Research Question 2 asks: In what ways can AI dependency affect students' critical thinking and problem-solving skills? The literature generally shows that excessive reliance on AI can reduce students' independent thinking and cognitive effort. Zhai et al. (2024), Adesokan et al. (2025), Goh et al. (2025), Szmyd and Mitera (2024), and Zhang et al. (2025) indicate that students who rely heavily on AI may become more likely to accept ready-made answers instead of analyzing information and developing their own solutions. Zhai et al. (2024) specifically found that over-reliance on AI dialogue systems can negatively affect students' cognitive abilities, including critical thinking and problem-solving. This finding is also supported by Stadler et al. (2024), who found that although LLMs reduced students' mental effort, students showed weaker reasoning and argumentation. Therefore, AI can make academic tasks easier and faster, but my excessive reliance may reduce the cognitive effort students need to understand and solve problems independently

Similar concerns are also found in Fan et al. (2025) and Morales-Garcia et al. (2024), who highlight the possibility that frequent AI use can encourage students to depend on AI when completing academic tasks. When students repeatedly use AI to provide answers or solutions, they may have fewer opportunities to practice analysis, evaluation, reflection, and independent decision-making. This is important because critical thinking and problem-solving require students to actively process information rather than simply receive an answer. However, the findings across the literature are not completely negative. Melisa et al. (2025), show that AI can also support critical thinking when students use it actively and critically. For example, students can use AI to compare different perspectives, ask questions, analyze information, and evaluate the quality of an answer instead of accepting it immediately.

Hou et al. (2025) further explain this difference by showing that students can use generative AI in reflective, cautious, collaborative, or thoughtless ways. Reflective and cautious use involves checking, evaluating, and improving AI-generated answers before using them. As Hou et al. (2025, p. 1923) explain, thoughtless use involves students who "copy AI-generated content with limited modification." Tian and Zhang (2025, p. 1) further found "that greater AI dependence was associated with lower levels of critical thinking, with cognitive fatigue partially mediating this relationship". Overall, the literature suggests that AI dependency can weaken students' critical thinking and problem-solving when AI replaces their own cognitive effort and independent reasoning. However, AI can support these skills when students remain actively involved in questioning, evaluating, and improving AI-generated information. Therefore, the main issue is not simply that use of AI, but excessive and uncritical dependence on AI.

Implications and Limitations

Implications.

The results of this literature review have significant implications for learning and teaching in higher education institutions. According to the results of Research Questions 1 and 2, the overuse of artificial intelligence (AI) can influence not only the way students perform academic tasks but also their knowledge acquisition, development of thinking skills, and learning independence. If students use AI for answer generation, explanation of concepts, or problem solving without putting enough effort on their own part, they might have less chance to practice information processing, critical thinking, and problem-solving. This means that the criteria of success at the academic level cannot be limited solely to the quality of assignments done by students.



From the standpoint of students, this study draws attention to the significance of adopting a responsible approach towards working with AI and developing an ability to regulate this activity. Students need to interact with the educational material, assess the information given by AI and treat its answers as just an initial point for further consideration. For instance, students may try to give their answers to some questions first, then consult with AI to see whether they were right or wrong and receive more explanation of the issue. Thus, students may get the benefits from working with AI and stay capable of critical thinking and problem-solving on their own.

The research provides recommendations for teachers and educational institutions, which is related to incorporating AI literacy into the process of teaching and studying. Not only students must be taught how to work with AI systems but also how to critically analyze the information generated by AI. In this regard, teachers can design assignments that will ask students to explain their thought process, compare sources, provide justification for their answer and think through how they reached a particular conclusion. Assessments may consist of oral explanations, discussions, drafts and problem-solving to evaluate students' understanding of the material.

Nonetheless, the research findings are not an indicator that the use of AI in education should be shunned. According to the research findings for Research Question 1, it is noted that appropriate use of AI may aid in various areas of learning among students, such as student engagement, knowledge construction, and learning outcomes as seen in the works by Lee et al. (2024) and Chen and Cheung (2025). In the same manner, according to the research findings for Research Question 2, AI can foster critical thinking skills among students where there is questioning, analysis, and evaluation of the information provided by AI. Consequently, the primary issue in education regarding the use of AI is not necessarily the use itself but rather the level of reliance on it and how it is used.

Limitations.

It is necessary to discuss the limitations of this literature review as well. Firstly, the review is based on selected studies that have been found using Google Scholar, ScienceDirect, Springer, ResearchGate, Frontiersin, and ERSJ search engines. It means that relevant literature that has been found in other databases can be missed. Secondly, only studies published in 2022-2025 were analyzed. The time range chosen for the analysis covers the most recent discussions regarding AI dependence among students, but there are no studies published earlier and later than within the chosen period of time. Thirdly, the results of the literature review depend on the selected articles, their methods, participants, and contexts. It means that differences in the educational context, characteristics of participants, AI tools used, and definitions of AI dependency can influence the results. Therefore, the results of this literature review should not be considered as evidence of the fact that high dependence on AI affects all students in the same way. Finally, this study cannot provide independent evidence of the effect of AI dependency on learning performance or cognitive skills of students as it uses only the information that has already been provided by others without conducting any direct studies with participants.





CONCLUSION

The use of Artificial Intelligence (AI) has become increasingly common nowadays, especially among students, including university students. Generative AI helps students complete their assignments by finding references, searching for learning materials, and asking questions to gain a better understanding of certain topics. However, the use of AI can be seen as a double-edged sword because it has both positive and negative effects. On the positive side, AI can help students complete their assignments and understand learning materials more effectively. Nevertheless, AI should be used carefully, reflectively, actively, and critically.

In contrast, the negative use of AI, often referred to as AI dependency, can weaken students' learning processes, reduce their critical thinking skills, and limit their problem-solving skills, especially when solving problems independently. Excessive dependence on AI may reduce the cognitive effort students need to understand information and solve problems on their own. This dependency can be seen when students use AI-generated answers to complete assignments without making meaningful modifications. As a result, students may become less capable of analyzing, evaluating, reflecting on, and making decisions independently.

Therefore, the use of AI should be balanced with critical and evaluative thinking. AI can support students' cognitive development when they remain actively involved in questioning, evaluating, and improving the information generated by AI. Thus, the main problem does not lie in the use of AI itself, but in excessive dependence on AI without critical thinking or proper evaluation.

These findings suggest that teachers and educational institutions should encourage responsible AI use by integrating AI literacy into teaching and learning. Teachers can design assignments that require students to explain their reasoning, evaluate AI-generated information, and solve problems independently. Future studies may further examine how different patterns of AI use influence students' learning processes, critical thinking, and problem-solving skills.

Acknowledgments

The researchers would like to express their gratitude to Musi Charitas Catholic University in Palembang for supporting this research by providing access to facilitating participation in an international conference this year, which enabled the dissemination of this paper. The researchers also extend their sincere appreciation to the Academic Reading and Writing course for the valuable insights, knowledge, and guidance that contributed to the development of this research paper.





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