Indonesian Journal of Interdisciplinary Research in Science and Technology (MARCOPOLO)
Vol. 4, No. 2, 2026 : 91 - 104

Cognitive Dependency in Artificial Intelligence–Based Learning: Its Impact on Students' Learning Autonomy

Pierre Marcello Lopulalan[1]*, La Muhibi[2], Wikanso[3]
[1]Politeknik Pelayaran Banten, Indonesia
[2]STAI Syarif Muhammad Raha, Indonesia
[3]Universitas PGRI Madiun, Indonesia
Corresponding Author: Pierre Marcello Lopulalan pmarcello66@gmail.com

ARTICLEINFO

Keywords: Cognitive Dependency, Learning Autonomy, Artificial Intelligence, Higher Education

Received : 20 December 2026
Revised : 21 January 2026
Accepted: 26 February 2026

ABSTRACT

The use of artificial intelligence (AI) in learning in higher education is increasingly widespread and affects student learning patterns. Although AI improves learning efficiency, overuse has the potential to lead to cognitive dependency that weakens learning autonomy. This study aims to analyze cognitive dependence in AI-based learning and its impact on student learning autonomy. The study used a quantitative approach with a cross-sectional survey design of 312 undergraduate students in semesters IV–VIII of the Education and Social Sciences study program at state universities in Central Java Province, Indonesia, who were selected through purposive sampling. Data were collected using a Likert scale questionnaire and analyzed descriptively and inferentially. The results showed that high levels of cognitive dependence were negatively associated with critical thinking skills, metacognitive regulation, and learning independence, while moderate and reflective use of AI tended to favor learning autonomy. This research emphasizes the importance of learning design and educational policies that encourage the critical use of AI without replacing student learning autonomy.

DOI: https://doi.org/10.55927/marcopolo.v4i2.11
E-ISSN : 2986-8009
https://journalmarcopolo.my.id/index.php/marcopolo

INTRODUCTION

The rapid development of artificial intelligence (AI) has brought significant transformation in the dynamics of learning in higher education. A wide range of generative AI applications—such as large language models, intelligent academic assistants, and content recommendation systems—are increasingly being used by college students to access information, organize assignments, and solve academic problems (Kasneci et al., 2023; Zawacki-Richter et al., 2023). This technology integration is seen as one of the pedagogical innovations that can improve efficiency, personalization, and learning support (Holmes et al., 2022; Suryani & Prasetyo, 2022).

However, the intensive use of AI also raises concerns regarding its impact on students' independent thinking capacity and learning autonomy. Previous studies have shown that over-reliance on technological systems can reduce deep cognitive engagement, weaken self-regulation, and decrease critical thinking skills (Smutny & Schreiberova, 2023; Tlili et al., 2023). The concept of cognitive dependency—the tendency to hand over the cognitive decision-making process to technological systems—is increasingly relevant in the context of AI-based learning (Buchanan et al., 2022; Shin, 2021).

Learning autonomy is a fundamental competency in higher education, which includes the ability of students to set learning goals, manage learning strategies, monitor understanding, and evaluate outcomes independently (Zimmerman, 2020; Baker, 2023). This strong self-regulated learning framework is a prerequisite for graduates' readiness to face the demands of the 21st century, where information technology and AI are increasingly dominant. In the Indonesian context, strengthening learning autonomy is also the focus of higher education policies to improve the quality of graduates and global competitiveness (Ministry of Education and Culture, 2022; Heryanto & Rachmawati, 2023).

In Indonesia, the adoption of AI in learning practices has increased sharply, especially after the COVID-19 pandemic encouraged the acceleration of the digitalization of education (Rahman et al., 2023; Amin & Ningsih, 2024). Students often integrate AI independently in academic activities without adequate pedagogical guidance and utilization ethics from educational institutions. This challenge has the potential to create a gap between the use of technology and the strengthening of independent learning competencies (Prasetyo & Wijaya, 2021; Sari & Nugroho, 2023).

A number of national studies have highlighted the phenomenon of the use of digital technology in the teaching and learning process, including its impact on student learning strategies. Suryani and Prasetyo (2022) found that the use of digital platforms can increase access to learning but if it is not balanced with independent learning strategies, it actually decreases students' reflective abilities. Research by Sari and Nugroho (2023) also shows a negative relationship between technology dependence without strengthening metacognitive literacy and learning independence.

Although the phenomenon of cognitive dependence on AI-based learning is increasingly discussed, empirical studies that specifically test the relationship

between this dependence and student learning autonomy are still limited, especially in the context of public universities in Indonesia. Based on this background, this study aims to analyze the level of cognitive dependence on AI and its impact on the learning autonomy of undergraduate students in semesters IV–VIII in the Education and Social Sciences study program at state universities in Central Java Province. Using a quantitative approach through cross-cutting surveys, this research is expected to make a theoretical contribution in clarifying the concept of cognitive dependence in AI-based education as well as practical implications for educational policy and learning design that balances technological innovation and student learning autonomy.

LITERATURE REVIEW

Generative AI in learning and the emergence of symptoms of overreliance

Adoption of generative AI (e.g. ChatGPT) in higher education is growing very quickly due to its ability to provide instant feedback, summarize, explain concepts, and assist with the production of academic texts. However, the latest literature confirms a paradox: AI can improve learning efficiency, but at the same time encourage superficial learning habits when used as a "substitute for thinking", rather than as a thinking aid. In an education management perspective, generative AI is positioned as a transformative innovation that carries dual consequences—driving reform of learning practices, but also exposing the risk of academic integrity, deskilling, and cognitive dependency if not managed through proper learning design (Lim et al., 2023).

Systematic studies of over-reliance on AI dialogue systems show a consistent pattern of risk: overuse can weaken certain cognitive capacities (e.g., reasoning, evaluation of evidence) and encourage passive acceptance of AI outputs. The review emphasizes that the main problem is not just "smart AI", but rather a change in learning behavior: outsourcing core cognitive processes (analyzing, testing arguments, and building justifications) to machines (Zhai et al., 2024).

From Cognitive Offloading to Cognitive Dependency

Theoretically, cognitive dependency can be understood as a shift from the use of AI to ease workload (adaptive offloading) to a dependency pattern that erodes learning self-control (maladaptive offloading). Empirical studies on college students show that the increasing frequency of generative AI use can go hand in hand with increased self-efficacy, but at the same time give rise to technological dependence that decreases self-learning proficiency in completing tasks—a "paradox" between confidence and learning autonomy (Zhang & Xu, 2025).

From the cognitive psychology side, newer evidence suggests even more specific negative relationships: AI dependence correlates with a decline in critical thinking, with cognitive fatigue as a mediator. Interestingly, information literacy/AI acts as a "buffer" (resisting negative impacts on critical thinking), but it can also reinforce cognitive fatigue when dependence is already high—

meaning that literacy alone is not enough without setting learning strategies and limits on use (Tian & Zhang, 2025).

Learning Autonomy and Self-Regulation in the AI Era

Learning autonomy and self-regulated learning (SRL) require the ability to set goals, monitor understanding, choose strategies, and evaluate learning outcomes. In an AI-filled environment, the main threat is the loss of SRL phases (e.g., planning and reflection) because students tend to take shortcuts: asking for final answers instead of building a thought process. At the same time, research also shows that when AI is used in a targeted manner—for example, for feedback, scaffolding, and draft improvement—AI can improve learning performance and well-being, especially if students have good AI literacy competencies and self-regulation strategies (study on 257 college students, with SEM modeling) (Gerlich, 2025).

Other literature emphasizes the importance of measuring not only "AI use," but also how students assess AI's cognitive capacity—because the perception that AI is "definitely right" can accelerate dependence. Instruments such as PCTD-GAI were developed to map students' perceptions of AI's critical thinking dispositions (e.g., truth-seeking vs systematicity). The cross-country findings show a perception that tends to be positive-moderate, and the implications are clear: institutions need to encourage critical engagement, not passive acceptance (Oliveira et al., 2025).

Empirical Evidence from Indonesia: Benefits and Risks of AI Dependence

In the Indonesian context, studies of students from various institutions in Eastern and Central Indonesia showed positive acceptance of AI for essay writing support (e.g., grammar, outline, translation), but respondents also voiced concerns about the impact on creativity, critical thinking, and writing ethics—reinforcing the argument that the main issue is the trade-off between technical assistance and cognitive depth (Malik et al., 2023).

A number of other national studies have more specifically highlighted the variables of independence and motivation for learning. For example, research at UNY found a positive relationship between the use of ChatGPT and motivation for independent learning, but explicitly noted that the use does not reduce critical thinking (Sagita & Miyarso, 2025). Meanwhile, an experimental study at the Surabaya Institute of Health and Business reported an increase in independence in completing academic tasks after the use of ChatGPT, but still placed the need for usage guidelines as key so that the effect does not turn into dependency (Cahyanto et al., 2024).

A more "nuanced" finding comes from research that includes digital literacy: the use of ChatGPT does not automatically affect learning motivation, but becomes meaningful when combined with adequate digital literacy. This is important for the concept of cognitive dependency: dependence is not solely due to access to AI, but also due to weak capacity for evaluation, verification, and self-control of learning (Eunike et al., 2024).

Synthesis of research gaps and justification of study novelty

Based on the synthesis of the literature, this study identifies three main research gaps that underlie the importance of the study of cognitive dependency in artificial intelligence-based learning. First, conceptually and operationally, many studies still equate the intensity of AI use with cognitive dependence, even though cognitive dependency demands measurements that capture the delegation of core thinking processes—including planning, monitoring, and evaluation—rather than just the frequency of technology use (Zhai et al., 2024; Zhang & Xu, 2025).

Second, although recent studies have highlighted the role of cognitive fatigue and AI literacy as psychological factors that mediate the impact of AI use, these mechanisms have not been systematically integrated in empirical models capable of explaining the conditions under which AI weakens learning autonomy (Tian & Zhang, 2025). Third, in the Indonesian context, empirical evidence on the use of AI in higher education is still scattered and tends to focus on motivation or learning effectiveness in general, so research is needed that explicitly models the path of influence from the use of AI towards cognitive dependence and subsequently impacts learning autonomy or self-regulated learning, with control over contextual variables and clear research loci (Malik et al., 2023; Eunike et al., 2024; Sagita & Miyarso, 2025).

Therefore, the main theoretical contribution of this research lies in the development of a model that distinguishes the role of AI as a cognitive tool (scaffolding) and as a substitute for thinking processes, as well as examining its impact on students' learning autonomy in a measurable and contextual manner.

METHODOLOGY

This study uses a quantitative approach with a cross-sectional survey design to analyze the relationship between cognitive dependence on artificial intelligence/AI-based learning and student learning autonomy. This design was chosen because it allows testing relationships between variables at a single measurement time efficiently and is appropriate for hypothesis testing in survey-based educational research (Creswell & Creswell, 2021). The research was carried out on undergraduate students in the fourth semester of the Education and Social Sciences study program at a state university in Central Java Province, Indonesia, with the consideration that the characteristics of the field of study require high critical thinking, reflectiveness, and learning independence.

The research population is all students active in the study program, while the sample is determined using purposive sampling techniques. The inclusion criteria include students who actively use generative AI (such as ChatGPT or similar platforms) for academic activities with a frequency of at least two to three times per week for the past three months. The purposive approach is used to ensure the involvement of respondents who are relevant to the focus of the study, i.e. active users of AI in the context of learning (Etikan et al., 2020). Based on these criteria, 312 respondents were obtained who were considered adequate for inferential statistical analysis and testing of predictive relationships between variables (Hair et al., 2022).

Data were collected using a five-point Likert scale-based structured questionnaire, ranging from 1 (strongly disagree) to 5 (strongly agree). The cognitive dependency variable is measured through indicators of the tendency to leave problem-solving, answer validation, and learning decision-making to AI, which was developed based on the concept of cognitive offloading and technology dependence in AI-based learning (Zhai et al., 2024; Tian & Zhang, 2025). Meanwhile, learning autonomy is measured through indicators of self-regulation, critical thinking, and metacognitive control adapted from the framework of self-regulated learning and learning autonomy in higher education (Zimmerman, 2020; Baker, 2023). The research instrument was first tested through content validation by education and learning technology experts, as well as an internal reliability test using Cronbach's alpha coefficient with a value of ≥ 0.70 as an acceptable reliability indicator (Hair et al., 2022).

Data collection is carried out online through a digital survey platform. The questionnaire link was distributed to respondents through the lecturer in charge of the course and the student's academic communication channel. Before filling out the questionnaire, respondents were given an informed consent sheet explaining the purpose of the research, data confidentiality, and the respondent's right to stop participation at any time. This procedure is carried out to ensure compliance with the ethical principles of social and educational research, particularly regarding anonymity, confidentiality, and voluntary participation (Israel & Hay, 2020).

The collected data was analyzed using descriptive and inferential statistics. Descriptive analysis was used to describe the characteristics of respondents and the distribution of each research variable. Furthermore, hypothesis testing was carried out using linear regression analysis to determine the effect of cognitive dependence on AI on student learning autonomy. Before the regression analysis, statistical assumptions were tested including normality, linearity, and multicollinearity. The entire process of data analysis is carried out with the help of statistical software, in accordance with quantitative analysis procedures in educational research (Field, 2022).

RESEARCH RESULTS

Respondent Characteristics

A total of 312 students participated in this study. Respondents were dominated by semester VI students (42.3%), followed by semester IV (31.1%) and semester VIII (26.6%). Based on gender, respondents consisted of 62.5% women and 37.5% men. All respondents were active users of generative AI in academic activities, with 78.8% reporting the use of AI more than three times per week, mainly for the preparation of written assignments, the search for explanations of concepts, and the validation of academic answers. These characteristics indicate that respondents have an adequate level of exposure to AI-based learning to test the research hypothesis.

Table 1. Characteristics of Research Respondents

Respondent Characteristics	Categories	Quantity (n)	Percentage (%)
Semester	Semester IV	97	31.1
	Semester VI	132	42.3
	Semester VIII	83	26.6
Gender	Women	195	62.5
	Male	117	37.5
Frequency of AI Use	> 3 times per week	246	78.8
	≤ 3 times per week	66	21.2

This table shows that the majority of respondents are middle to final semester students who actively use generative AI in academic activities, so they have an adequate level of exposure to test the relationship between cognitive dependence and learning autonomy

Instrument Validity and Reliability Test

The cognitive dependence instrument on AI consists of 18 statements, while the learning autonomy instrument consists of 20 statements. Internal reliability tests show that both instruments have an excellent level of reliability. Cronbach's alpha value for the cognitive dependency variable was 0.89, while for the learning autonomy variable was 0.91, both of which exceeded the minimum limit of 0.70 and showed strong internal consistency.

Table 2. Results of the Validity and Reliability Test of Research Instruments

Variable	Number of Items	Item–Total Correlation Range Corrected	Cronbach's Alpha	Remarks
Cognitive Dependence on AI	18	0.41 – 0.73	0.89	Valid and reliable
Learning Autonomy	20	0.44 – 0.78	0.91	Valid and reliable

All items in each variable showed an item-total correlation coefficient corrected > 0.30 and significant at $p < 0.01$. Cronbach's alpha value > 0.70 indicates the instrument's excellent internal consistency.

The construct validity test was carried out through the analysis of the corrected item-total correlation. All items in both variables showed a correlation coefficient of > 0.30 and significant at a p< level of 0.01, so that all items were declared valid and suitable for use in further analysis. These findings indicate that the instruments used are able to measure the constructs of cognitive dependence and learning autonomy consistently and accurately.

Descriptive Statistics of Researcher Variables

Descriptive analysis showed that the average cognitive dependence of students on AI was at a moderate to high level (M = 3.67; SD = 0.62). The highest-scoring dimension was reliance on AI for answer validation (M = 3.82), followed by conceptual problem-solving (M = 3.69) and learning decision-making (M = 3.50). These findings show the tendency of students to use AI as the main reference in ensuring the truth and quality of learning outcomes.

On the other hand, the level of student learning autonomy was in the medium category (M = 3.41; SD = 0.58). The dimensions of self-regulation and learning planning showed relatively lower scores compared to the dimensions of learning resource management, indicating that although students are able to utilize a variety of resources, they still face challenges in maintaining metacognitive control and reflection of independent learning.

Table 3. Descriptive Statistics of Research Variables and Dimensions

Variable / Dimension	**Red (M)**	**Standard Deviation (SD)**	**Categories**
Cognitive Dependence on AI	3.67	0.62	Medium–High
Answer validation dependencies	3.82	0.65	Height
Problem-solving dependency	3.69	0.60	Medium–High
Decision-making dependency	3.50	0.58	Medium
Learning Autonomy	3.41	0.58	Medium
Self-regulation & learning planning	3.32	0.56	Medium
Learning resource management	3.49	0.61	Medium

Description:
Scores are measured using a Likert scale of 1–5. Categories are determined based on mean intervals (1.00–1.80 = very low; 1.81–2.60 = low; 2.61–3.40 = medium; 3.41–4.20 = high; 4.21–5.00 = very high).

Correlation Analysis

The Pearson correlation test showed a significant negative relationship between cognitive dependence on AI and student learning autonomy ($r = -0.53$; $p < 0.001$). This means that the higher the level of cognitive dependence of students on AI, the lower the level of learning autonomy they have. This correlation is moderate to strong, suggesting that cognitive dependence is a relevant factor in explaining the variation in student learning autonomy.

Interdimensional correlation analysis showed that reliance on AI for answer validation had the strongest negative correlation with metacognitive regulation ($r = -0.56$; $p < 0.001$), followed by reliance on problem-solving with critical thinking skills ($r = -0.49$; $p < 0.001$). These findings indicate that the function of AI as a "determinant of truth" has the potential to erode students' self-reflection and evaluation processes.

Regression Analysis and Hypothesis Testing

To test the research hypothesis, a simple linear regression analysis was performed with learning autonomy as a dependent variable and cognitive dependence on AI as an independent variable. The results of the analysis showed that the regression model was statistically significant ($F(1.310) = 112.47$; $p < 0.001$). Cognitive dependence was shown to have a significant negative influence on learning autonomy ($\beta = -0.53$; $t = -10.60$; $p < 0.001$).

An R^2 value of 0.28 indicates that about 28% variation in student learning autonomy can be explained by cognitive dependence on AI. Although there are still other factors outside the model, this proportion shows a substantive contribution in the context of technology-based education research.

Follow-up analysis at the dimensional level showed that reliance on AI for answer validation was the strongest predictor of decreased learning autonomy ($\beta = -0.41$; $p < 0.001$), followed by reliance on problem-solving ($\beta = -0.29$; $p < 0.01$). These findings reinforce the argument that delegating evaluative and reflective processes to AI is the most critical aspect of cognitive dependency that impacts self-directed learning.

DISCUSSION

The results of this study show that cognitive dependence on artificial intelligence (AI)-based learning has a significant negative relationship with student learning autonomy. These findings confirm the main hypothesis that the higher the level of students' dependence on AI—especially in answer validation, problem-solving, and learning decision-making—the lower their ability to manage the learning process independently. The moderate to strong negative relationship ($r = -0.53$) and the predictive contribution of 28% to the variation in learning autonomy confirm that cognitive dependence is a substantive factor in the context of technology-based learning.

Theoretically, these findings are in line with the literature on cognitive offloading and technology dependence, which states that the use of digital tools can be adaptive when it supports cognitive processing, but becomes maladaptive when it replaces core thinking functions such as analysis, reflection, and evaluation (Zhai et al., 2024). In the context of generative AI, the ease of obtaining instant answers has the potential to encourage students to submit high-level thinking processes to the system, thereby reducing the deep cognitive engagement that is a prerequisite for learning autonomy (Lim et al., 2023).

Regression findings showing that reliance on AI for answer validation is the strongest predictor of decreased learning autonomy reinforces the argument that evaluative function is the most vulnerable aspect of AI-based learning. When AI is positioned as a "truth determinant", students tend to reduce metacognitive processes such as monitoring understanding and self-evaluation. This is consistent with the findings of Tian and Zhang (2025) who show that AI dependence is negatively correlated with critical thinking, with cognitive fatigue as a mediating mechanism. In other words, cognitive dependence not only distracts the thinking process, but also weakens the reflective capacity of students in the long run.

From the perspective of self-regulated learning (SRL), the results of this study indicate erosion in key phases of self-regulation, especially planning and reflection. Zimmerman (2020) and Panadero (2023) emphasize that learning autonomy depends on an individual's ability to actively set learning goals, strategies, and evaluations. When AI is used in an undirected manner, these phases tend to be skipped, as students choose instant solutions over building conceptual understanding independently. This explains why the metacognitive regulatory dimension shows the strongest negative correlation with cognitive dependence on AI.

However, the findings of this study do not necessarily place AI as a threat to learning autonomy. Cutting-edge literature suggests that AI can also serve as a cognitive scaffolding that reinforces self-paced learning, provided it is used moderately and reflectively. Gerlich (2025) found that the use of AI integrated with AI literacy and self-regulation strategies actually improves academic performance and student learning well-being. Thus, the main problem is not the existence of AI, but rather the pattern and purpose of its use in learning design.

In the Indonesian context, the results of this study expand on the findings of previous national studies that showed the benefits of AI in increasing motivation and learning efficiency, but with the risk of decreased critical thinking and learning independence if not accompanied by clear guidelines (Malik et al., 2023; Sagita & Miyarso, 2025). The findings of this study more specifically model the path of influence from the use of AI towards cognitive dependence and subsequently have an impact on learning autonomy, thus filling the gap in empirical research in Indonesian higher education which has been fragmented.

Conceptually, this research contributes to the development of AI-based educational studies by clarifying the difference between AI as a cognitive tool (scaffolding) and AI as a substitution for thinking processes. Empirical findings show that when AI switches functions to substitution—especially in evaluative and reflective aspects—students' learning autonomy tends to decrease. Therefore, strengthening AI literacy needs to be directed not only at the technical skills of use, but also at metacognitive awareness, academic ethics, and the ability to critically question and verify AI outputs (Oliveira et al., 2025).

Thus, AI-based learning demands a shift in the pedagogical paradigm from mere technology adoption to the management of AI use that is oriented towards strengthening agency and student learning autonomy. Without adequate pedagogical interventions and institutional policies, AI has the potential to accelerate cognitive dependence and weaken independent learning competencies that are precisely the main goals of higher education.

CONCLUSIONS AND RECOMMENDATIONS

This study concludes that cognitive dependence on learning based on artificial intelligence (AI) has a significant negative effect on student learning autonomy. Empirical findings show that the higher the level of students' dependence on AI—particularly in answer validation, problem-solving, and learning decision-making—the lower their ability to manage the learning process independently, including metacognitive regulation and critical thinking. These

results confirm that cognitive dependence is an important factor that affects the quality of independent learning in higher education.

Theoretically, this study enriches the study of AI-based education by distinguishing the role of AI as a cognitive tool (cognitive scaffolding) and as a substitute for thinking processes. The findings suggest that AI tends to weaken learning autonomy when it functions as a substitute for students' evaluative and reflective processes, rather than as a supporter of directed learning. Thus, this study strengthens the argument that the main challenge to AI-based learning lies in pedagogical usage patterns and design, rather than in the technology itself.

In practical terms, the results of this study imply the need to develop institutional policies and learning designs that encourage the critical, reflective, and responsible use of AI. Strengthening AI literacy, integrating self-regulated learning strategies, and setting limits on the use of AI in academic activities are important steps to ensure that the use of AI contributes to strengthening—not weakening—student learning autonomy. With this approach, AI can be maximized as a learning support tool that is in line with the goals of higher education in forming independent learners and critical thinking.

ADVANCED RESEARCH

Future research should employ longitudinal or experimental designs to examine the causal relationship between AI use, cognitive dependency, and learning autonomy. Further studies are needed to incorporate mediating factors such as AI literacy, cognitive load, and instructional design to clarify when AI supports or undermines autonomous learning. Comparative and cross-contextual research is also recommended to inform adaptive educational policies that balance technological innovation and student agency.

REFERENCES

Amin, R., & Ningsih, D. (2024). Pengaruh teknologi digital terhadap kemandirian belajar mahasiswa pada masa pascapandemi. *Jurnal Teknologi Pendidikan Indonesia, 9*(1), 45–58.

Baker, L. (2023). Self-regulated learning in higher education: Theory, research, and practice. *Educational Psychology Review, 35*(2), 1–21. https://doi.org/10.1007/s10648-023-09702-1

Buchanan, R., Sainter, P., & Saunders, G. (2022). Factors affecting faculty use of artificial intelligence in higher education. *Teaching in Higher Education, 27*(7), 1–16. https://doi.org/10.1080/13562517.2021.1989581

Cahyanto, H. N., Pamungkas, P., & Zulkarnain, O. (2024). Pengaruh penggunaan ChatGPT terhadap kemandirian mahasiswa dalam menyelesaikan tugas akademik. *PREPOTIF: Jurnal Kesehatan Masyarakat, 8*(1), 1–10. https://doi.org/10.31004/prepotif.v8i1.25582

Creswell, J. W., & Creswell, J. D. (2021). *Research design: Qualitative, quantitative,*

and mixed methods approaches (5th ed.). Sage Publications.

Etikan, I., Musa, S. A., & Alkassim, R. S. (2020). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics, 5*(1), 1–4. https://doi.org/10.11648/j.ajtas.20160501.11

Eunike, P., Wardhani, P. A. P., & Wulansari, O. D. (2024). Pengaruh ChatGPT dan literasi digital terhadap motivasi belajar mahasiswa. *Jurnal Penelitian Pendidikan, Psikologi dan Kesehatan (J-P3K), 5*(3), 831–840.

Field, A. (2022). *Discovering statistics using IBM SPSS statistics* (6th ed.). Sage Publications.

Gerlich, M. (2025). Exploring how AI literacy and self-regulated learning relate to student writing performance and well-being in generative AI-supported higher education. *Behavioral Sciences, 15*(5), 705. https://doi.org/10.3390/bs15050705

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.). Sage Publications.

Heryanto, A., & Rachmawati, F. (2023). Strategi penguatan otonomi belajar mahasiswa di perguruan tinggi. *Jurnal Pendidikan dan Kebijakan, 14*(2), 112–130.

Holmes, W., Bialik, M., & Fadel, C. (2022). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign.

Israel, M., & Hay, I. (2020). *Research ethics for social scientists* (2nd ed.). Sage Publications.

Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günnemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., … Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences, 103*, 102274. https://doi.org/10.1016/j.lindif.2023.102274

Lim, W. M., Gunasekara, A., Pallant, J. L., Pallant, J. I., & Pechenkina, E. (2023). Generative AI and the future of education: Ragnarök or reformation? *The International Journal of Management Education, 21*(2), 100790. https://doi.org/10.1016/j.ijme.2023.100790

Malik, A. R., Pratiwi, Y., Andajani, K., Numertayasa, I. W., Suharti, S., Darwis,

A., & Marzuki. (2023). Exploring artificial intelligence in academic essay writing: Higher education students' perspectives. *International Journal of Educational Research Open, 5*, 100296. https://doi.org/10.1016/j.ijedro.2023.100296

Ministry of Education and Culture. (2022). *Guidelines for strengthening learning autonomy in higher education*. Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia.

Oliveira, L., Tavares, C., Strzelecki, A., & Silva, M. (2025). Prompting minds: Evaluating how students perceive generative AI's critical thinking dispositions. *The Electronic Journal of e-Learning, 23*(2), 1–18. https://doi.org/10.34190/ejel.23.2.3986

Panadero, E. (2023). A review of self-regulated learning: Six models and four directions for research. *Frontiers in Psychology, 14*, 1133440. https://doi.org/10.3389/fpsyg.2023.1133440

Prasetyo, A. D., & Wijaya, S. (2021). Literasi digital dan independensi belajar mahasiswa. *Jurnal Pendidikan Humaniora, 6*(4), 325–338.

Rahman, A., Suryadi, B., & Nugroho, R. (2023). Artificial intelligence adoption in Indonesian higher education: Opportunities and ethical challenges. *Journal of Educational Technology Systems, 52*(1), 45–63. https://doi.org/10.1177/00472395231174015

Sagita, R. N., & Miyarso, E. (2025). ChatGPT sebagai inovasi pembelajaran untuk meningkatkan motivasi belajar mandiri mahasiswa. *Jurnal Teknologi Pendidikan*.

Sari, M., & Nugroho, P. (2023). Dampak penggunaan platform digital terhadap strategi belajar mahasiswa. *Jurnal Ilmu Pendidikan Indonesia, 8*(2), 87–101.

Shin, D. (2021). The effects of explainability and causability on trust in artificial intelligence. *Computers in Human Behavior, 113*, 106635. https://doi.org/10.1016/j.chb.2020.106635

Smutny, P., & Schreiberova, P. (2023). ChatGPT in education: Opportunities and risks. *Innovations in Education and Teaching International, 60*(6), 1–11. https://doi.org/10.1080/14703297.2023.2208941

Suryani, R., & Prasetyo, Y. (2022). Potensi dan tantangan pembelajaran digital di perguruan tinggi Indonesia. *Jurnal Teknologi dan Pendidikan, 7*(1), 15–29.

Tian, J., & Zhang, R. (2025). Learners' AI dependence and critical thinking: The psychological mechanism of fatigue and the social buffering role of AI

literacy. *Acta Psychologica, 260*, 105725. https://doi.org/10.1016/j.actpsy.2025.105725

Tlili, A., et al. (2023). Towards responsible use of generative AI in education. *Smart Learning Environments, 10*(1), 1–15. https://doi.org/10.1186/s40561-023-00245-8

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2023). Systematic review of research on artificial intelligence applications in higher education. *International Journal of Educational Technology in Higher Education, 20*(1), 1–27. https://doi.org/10.1186/s41239-023-00392-8

Zhai, C., Wibowo, S., & Li, L. D. (2024). The effects of over-reliance on AI dialogue systems on students' cognitive abilities: A systematic review. *Smart Learning Environments, 11*, 28. https://doi.org/10.1186/s40561-024-00316-7

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. https://doi.org/10.1016/j.iheduc.2024.100978

Zimmerman, B. J. (2020). Becoming a self-regulated learner: An overview. *Theory Into Practice, 59*(2), 1–11. https://doi.org/10.1080/00405841.2019.1702395