



Artificial Intelligence in Higher Education: Exploring Learning Practices, Cognitive Offloading, and Policy Directions for Responsible AI Governance

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Abstract: This study uses a qualitative case study to understand how artificial intelligence (AI) is used in learning at the State Polytechnic of Cybersecurity and Cryptography (Poltek SSN), why students use it, and what impacts arise from its use. Data were collected during the 2025/2026 academic year through observations, interviews, and document analysis. The study involved nine informants: five students, three lecturers, and one educational staff member. The data were analyzed thematically and examined through triangulation, member checking, peer debriefing, and an audit trail. The findings identified three main patterns of AI use: as a learning aid, as a substitute for students' thinking processes, and as learning material. Students mainly used AI to understand learning materials, complete assignments, search for information, overcome limited study time and learning resources, and obtain quick responses. AI provided greater flexibility and efficiency in learning; however, excessive use may reduce students' cognitive engagement, motivation, and understanding and raise concerns about academic integrity. Therefore, the study recommends strengthening AI literacy, developing clear guidelines for AI use, and integrating AI into learning and assessment while maintaining students' responsibility for their thinking processes and learning outcomes.

Abstrak: Penelitian ini menggunakan studi kasus kualitatif untuk memahami bagaimana kecerdasan artifisial (AI) digunakan dalam pembelajaran di Politeknik Siber dan Sandi Negara (Poltek SSN), alasan mahasiswa menggunakannya, serta dampak yang muncul dari penggunaannya. Data dikumpulkan pada tahun akademik 2025/2026 melalui observasi, wawancara, dan studi dokumentasi. Penelitian ini melibatkan sembilan informan, terdiri atas lima mahasiswa, tiga dosen, dan satu staf pendidikan. Data dianalisis secara tematik dan diperiksa melalui triangulasi, *member checking*, *peer debriefing*, dan *audit trail*. Hasil penelitian menunjukkan tiga pola utama penggunaan AI, yaitu sebagai alat bantu belajar, sebagai pengganti proses berpikir mahasiswa, dan sebagai materi yang dipelajari. Mahasiswa menggunakan AI terutama untuk membantu memahami materi, menyelesaikan tugas, mencari informasi, mengatasi keterbatasan waktu dan sumber belajar, serta memperoleh jawaban dengan cepat. AI memberikan manfaat berupa fleksibilitas dan efisiensi belajar, tetapi penggunaan yang berlebihan dapat mengurangi keterlibatan kognitif, motivasi, dan pemahaman mahasiswa serta menimbulkan masalah terkait integritas akademik. Oleh karena itu, penelitian ini merekomendasikan penguatan literasi AI, penyusunan pedoman penggunaan AI, dan integrasi AI dalam pembelajaran serta asesmen dengan tetap menempatkan mahasiswa sebagai pihak yang bertanggung jawab atas proses berpikir dan hasil belajarnya.

A. Introduction

Technological developments in the era of digital transformation have accelerated the adoption of digital technologies, including Artificial Intelligence (AI), across higher education (Lubguban & Bauyot, 2025). However, AI integration is not straightforward because changes in educational ecosystems are complex and uncertain and depend on interactions among policy, technology, and user behavior (Patnaik & Paas, 2023; Holmes & Tuomi, 2022). AI has evolved from a computational tool into a technology supporting cognitive and learning processes through learning analytics, adaptive learning environments, and personalized feedback (Yan et al., 2024; Chen et al., 2020). These developments create opportunities to enhance learning while raising questions about how AI should be positioned and managed without reducing students' active engagement (Holmes, Bialik, & Fadel, 2019).

The pedagogical implications of AI integration are increasingly important as students and educators interact with AI in everyday learning. AI can function as an adaptive system requiring new forms of human-AI interaction and a complementary relationship between the two (Ulimaz et al., 2024). At the institutional level, higher education must respond to both the pedagogical opportunities and ethical risks of AI (Yusuf, 2025). Although AI provides rapid information access and learning efficiency, inappropriate or excessive use may encourage students to rely on AI rather than independently engage in critical thinking and problem-solving. This tension highlights the need to balance AI's benefits with students' cognitive engagement and responsibility for self-regulated learning (Schunk & Zimmerman, 2012; Jin et al., 2023).

Cognitive offloading provides an important lens for understanding this tension. It refers to relying on external resources to reduce or support cognitive demands (Risko & Gilbert, 2016). In AI-supported learning, it may occur when students use AI to obtain information, generate ideas, solve problems, or complete academic tasks. Although such use can provide cognitive support, excessive reliance may shift important thinking processes away from learners. Technological dependence may weaken critical thinking and problem-solving when students rely heavily on AI-generated outputs (Rahman et al., 2024), while easier information access may paradoxically reduce active cognitive engagement (Jose et al., 2025). Furthermore, treating AI as a cognitive crutch rather than a learning scaffold has been shown to negatively impact long-term knowledge retention (Barcaui, 2025). This concern is particularly evident when students accept AI-generated responses without examining their reasoning, evidence, or logic, effectively treating AI as a "black box" (Jose et al., 2025). From an Educational Technology perspective (Januszewski & Molenda, 2008), the central issue is therefore how AI is positioned within learning and whether it functions as a learning aid or substitutes for students' cognitive processes.

This issue is particularly relevant to the State Polytechnic of Cybersecurity and Cryptography (Poltek SSN), a government-affiliated institution specializing in cybersecurity and cryptography. Its educational environment emphasizes technological competence, which is closely related to graduate competencies. AI is consequently relevant

both as a technology encountered in learning and as an area of knowledge increasingly important to cybersecurity and digital technology. Students must therefore develop technological competence while maintaining appropriate academic practices and cognitive responsibility. At the same time, Poltek SSN presents an institutional tension: AI competence is increasingly relevant, while concerns about its academic use have also emerged. Preliminary observations indicate that some students may use AI pragmatically as a shortcut for completing assignments, particularly to save time. AI use motivated by convenience may undermine critical thinking (Kamil et al., 2025), while inappropriate use raises academic integrity concerns (Yan et al., 2024). In response, Poltek SSN has implemented restrictions, including blocking access to several AI platforms through its institutional network, reflecting efforts to protect academic integrity and manage emerging technological disruptions (Holmes & Porayska-Pomsta, 2022).

Previous studies have identified both opportunities and challenges associated with AI in education. AI can support personalized and adaptive learning, foster inclusive education (Melo-López et al., 2025), and potentially enhance student engagement (Chen et al., 2020), whereas excessive or inappropriate use has been associated with academic integrity concerns and declining critical thinking (Kamil et al., 2025). These contrasting perspectives suggest that AI's educational value depends not only on the technology but also on how it is incorporated into learning. Without clear pedagogical guidance, students may use AI primarily for task completion rather than meaningful learning. Effective learning environments should therefore enable AI to facilitate learning while students remain actively involved in analyzing, evaluating, and constructing knowledge. This is consistent with the view that meaningful educational transformation requires structured approaches to learning facilitation rather than unrestricted adoption or purely restrictive responses to AI (Apriadi & Sihotang, 2023).

Despite the growing literature on AI in higher education, important gaps remain. Research has frequently examined AI-based learning technologies, pedagogical benefits, and risks to academic integrity (Garzón et al., 2025), but less attention has been given to students' everyday AI practices and the reasons underlying them within institutions where AI use is specifically restricted. This gap is especially relevant in specialized government-affiliated institutions, where technological competence, information security, academic integrity, and learning practices intersect. At Poltek SSN, students may simultaneously experience AI as a learning resource, a means of reducing cognitive demands, and a technology subject to institutional constraints.

Accordingly, this study examines the AI paradox at Poltek SSN from an Educational Technology perspective. Rather than viewing inappropriate AI use solely as academic misconduct, it considers how AI is positioned within learning and how students manage their cognitive responsibilities. This perspective distinguishes AI use that supports learning from use that may substitute for students' cognitive processes and provides context-specific evidence for responsible AI use, instructional design, and institutional governance. The study employs a qualitative case study approach appropriate for examining contemporary

phenomena in real-world contexts when their boundaries with the context are closely intertwined (Yin, 2018). Specifically, it addresses two research questions: (1) How do students use AI in learning at Poltek SSN? and (2) Why do students use AI despite institutional restrictions? By addressing these questions, the study seeks to provide an in-depth understanding of students' AI-related learning practices and their underlying factors while informing appropriate instructional approaches and responsible AI governance in higher education.

B. Method

This study employed a qualitative approach using an exploratory single-case study design (Yin, 2018). The design was selected because the use of Artificial Intelligence (AI) at the State Polytechnic of Cybersecurity and Cryptography (Poltek SSN) represents a contemporary and complex phenomenon that occurs naturally within a specific institutional context without direct researcher manipulation. The case study approach enabled an in-depth examination of students' AI-related learning practices, the reasons underlying their use, and the institutional conditions surrounding the phenomenon. The study focused on the pedagogical dimensions and learning behaviors associated with AI use and did not evaluate the technical mechanisms, architecture, or algorithms of AI systems.

The study was conducted at Poltek SSN, a government-affiliated higher education institution specializing in cybersecurity and cryptography. Participants were selected through purposive sampling to obtain information-rich perspectives relevant to the phenomenon under investigation (Creswell & Poth, 2018). The participants consisted of nine informants: five active students who had been identified as using AI platforms in learning, three lecturers who had direct experience or observations of students' AI use during learning activities, and one educational staff member from the Computer Security Incident Response Team (CSIRT) who was involved in institutional network access and security policies. The primary research instrument was the researcher, supported by observation guidelines, semi-structured interview guidelines, and a documentation checklist.

Data were collected concurrently during the even semester of the 2025/2026 academic year, from January to April, using three techniques: non-participant observation, semi-structured interviews, and document analysis. Observations focused on academic activities and practices related to AI use and cognitive offloading. Interviews were conducted with participants who were currently using or had previously used AI in learning to explore their experiences, motivations, and practices. Documentary analysis examined relevant institutional policies and available digital footprints. Data collection was iterative and continued until informational redundancy was reached, indicated by the absence of new themes, insights, or perspectives concerning students' AI-use behaviors.

The collected data were analyzed thematically (Miles et al., 2014), following the methodological framework presented in Figure 1. The analysis began with repeated familiarization with interview transcripts, observation notes, and documentary materials. Meaningful segments were then coded according to patterns, reasons, and consequences of

AI use. Related codes were subsequently compared, refined, and grouped into broader categories, which were further synthesized into themes aligned with the research questions. This analytical process was iterative and continued alongside data collection until informational redundancy was achieved. To ensure trustworthiness, the study applied credibility, transferability, dependability, and confirmability criteria (Lincoln & Guba, 1985). Credibility was strengthened through methodological and source triangulation and member checking, while dependability and confirmability were supported through an audit trail and peer debriefing. Finally, ethical procedures were implemented by obtaining informed written consent, ensuring voluntary participation and the right to withdraw, and anonymizing participant identities and sensitive information throughout data management and reporting.

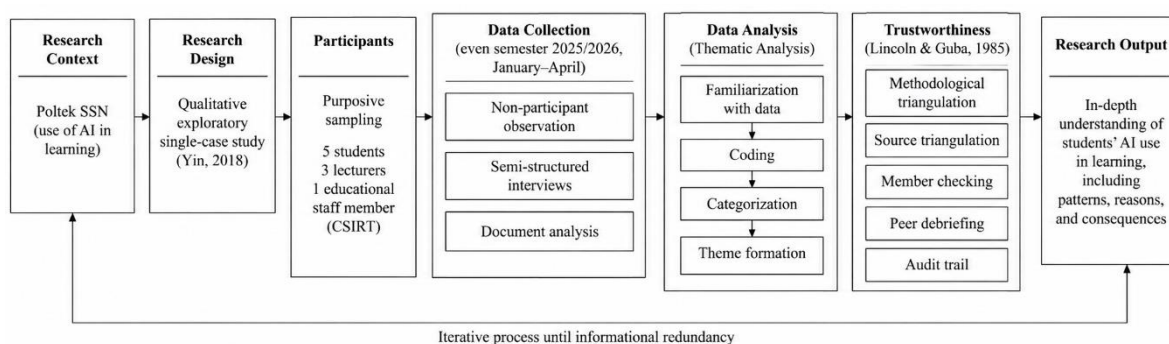


Figure 1. Methodological framework of the exploratory single-case study

C. Result

The analysis of interview, observation, and documentary data identified three main patterns of AI use in learning at Poltek SSN: AI as a learning aid, AI as a substitute for cognitive processes, and AI as learning material. The findings also identified four main reasons for AI use: cognitive support, limited learning resources, time constraints, and accessibility, speed, and responsiveness.

1. Patterns of AI Use in Learning

AI as a Learning Aid

Students used AI to assist with academic and technical activities, including assignment completion, coding, problem solving, summarizing learning materials, and searching for references. M2 stated:

"I use AI to help me complete assignments" (Interview, M2, March 5, 2026).

D2 also reported that students used AI to assist with their course assignments. AI was also used for coding and problem solving. M1 reported using ChatGPT and Claude for coding, while M3 used AI when he was unable to solve a problem independently. D1

confirmed that students used AI to summarize materials and generate code during practical activities.

"Sometimes I use ChatGPT and Claude for coding." (Interview, M1, March 4, 2026).

"I use AI when I am unable to solve a problem myself." (Interview, M3, March 6, 2026).

"Some students use AI to summarize materials and provide assistance during practical activities, particularly for generating code." (Interview, D1, March 13, 2026).

AI was also used for self-directed learning. M1 reported using AI to understand materials from books and journals and to summarize materials provided by lecturers. M2 reported that AI helped make learning and assignment completion faster, particularly when study time was limited.

"AI helps me understand materials from books or journals by analyzing the main points more quickly and creating summaries of the materials provided by the lecturer." (Interview, M1, March 4, 2026).

Students also used AI to search for references. Observation during the final project proposal seminar on March 4, 2026, showed students using AI to search for reference sources. M3 reported using AI when relevant learning resources were limited, while M4 reported using AI to search for references and answers.

"I use AI when learning resources are limited or unavailable" (Interview, M3, March 6, 2026).

"I use AI when I need help finding references and answers" (Interview, M4, March 6, 2026).

AI use was also observed during academic advising and examination activities. On March 5, 2026, during a final project proposal seminar, a lecturer instructed a student who was unable to answer a question to access ChatGPT and enter the lecturer's question. On March 12, 2026, similar AI use was observed during a comprehensive examination when students experienced difficulties answering questions. D3 reported providing students with guidance on prompting, while D1 reported instructing students to use AI during final project mentoring, including for script writing.

AI as a Substitute for Cognitive Processes

Observation during the final project proposal seminar on March 4, 2026, showed the use of AI to generate proposal content through a copy-and-paste process. The submitted

proposal content was reported in the observation record as being generated entirely through AI assistance.

Further evidence was obtained during a comprehensive examination on March 10, 2026. A student who had previously failed a penetration testing practical examination was unable to explain the contents of a submitted laboratory report. The student was subsequently required to retake the comprehensive examination by reproducing the procedures described in the report. D1 reported:

"In practical activities, some students use AI to write penetration testing reports, resulting in reports that are more creative, but so creative that the submitted reports go beyond the required format." (Interview, D1, March 13, 2026).

"The assignment is done carelessly; what matters is that it is finished, and it is less creative." (Interview, D1, March 13, 2026).

AI as Learning Material

Documentary analysis of the 2023 Curriculum Document for the Cybersecurity Engineering Study Program showed that AI was explicitly included in the *Introduction to Technology and Information* course (RKS113). AI was listed among the technologies that students were expected to master, together with Machine Learning, the Internet of Things (IoT), Industrial Control Systems (ICS), and Blockchain.

Table 1. Summary of AI Use Patterns and Supporting Evidence

AI use pattern	Specific use	Supporting evidence	Data source
AI as a learning aid	Assignment completion	AI used to assist with assignments	M2, D2
	Coding and problem solving	AI used for coding and when students encountered difficulties solving problems	M1, M3, D1
	Self-directed learning	AI used to understand and summarize books, journals, and lecturer-provided materials	M1, M2
	Reference searching	AI used to search for references and answers	M3, M4; observation
	Academic advising	Students instructed to use AI during proposal and examination activities	Observation; D1, D3
AI as a substitute for cognitive processes	Proposal generation	AI-generated content incorporated through copy-and-paste	Observation, March 4, 2026
	Report generation	AI used to produce penetration testing reports	D1
	Academic task completion	Student unable to explain previously submitted report	Observation, March 10, 2026
AI as learning material	Curriculum content	AI included in RKS113	2023 Curriculum Document

2. Reasons for AI Use

Cognitive Support

Students used AI when they encountered difficulties during learning activities. During the final project proposal seminar on March 4, 2026, students used AI assistance in drafting their proposals. During the penetration testing examination on March 5, 2026, students also used AI when experiencing difficulties identifying and analyzing server vulnerabilities. M1 stated:

"In the penetration testing course, we need to try different tools, which takes a long time. With AI, I can simulate attacks simultaneously, so it becomes a shortcut for finding vulnerabilities" (Interview, M1, March 4, 2026).

"When I am unable to solve a problem myself" (Interview, M3, March 6, 2026).

Limited Learning Resources

M3 reported using AI when learning resources were limited or unavailable. D2 similarly reported that some students used AI to explore additional material when they experienced difficulties understanding the provided modules.

"When learning resources are limited or unavailable, AI can help address the problem" (Interview, M3, March 6, 2026).

Time Constraints

Time constraints were also reported as a reason for using AI.

"Because of limited time, AI enables me to complete something more quickly within the available time" (Interview, M2, March 5, 2026).

"Limited time, so AI allows me to do things faster within a limited timeframe." (Interview, M5, March 12, 2026).

Accessibility, Speed, and Responsiveness

During the comprehensive examination on March 12, 2026, students experienced difficulties answering questions and performing laboratory activities. The lecturer instructed them to use AI. After entering their problems into the AI system, students received responses and suggested steps and subsequently continued the laboratory activity. M5 stated:

"When I need help with difficult problems, such as source-code requirements in software courses, I need a solution that is accurate and fast" (Interview, M5, March 12, 2026).

M1 stated:

"Its analysis feature is fast, which makes it easier for me to summarize a large amount of material" (Interview, M1, March 4, 2026).

Further evidence of the reasons for students' AI use is summarized in Table 2.

Table 2. Reasons for AI Use and Supporting Evidence

Reason	Evidence from data	Source
Cognitive support	AI used when students encountered difficulties in problem solving and technical activities	Observation; M1, M2, M3
Limited learning resources	AI used when relevant learning materials were limited or unavailable	M3, D2
Time constraints	AI used to complete tasks more quickly	M2, M5
Accessibility, speed, and responsiveness	AI provided rapid responses and suggested procedures for technical problems	Observation; M1, M5, D1

Reported and Observed Outcomes of AI Use

Participants reported increased flexibility in learning. M3 reported that AI could provide assistance when learning resources were limited, while D2 described its use for exploring material more broadly and obtaining personalized responses.

"AI is always available when I have a problem, so it can act like a consultant that provides suggestions for solving the problem" (Interview, M3, March 6, 2026).

Participants also reported increased efficiency. M2, M3, and M5 associated AI use with completing tasks more quickly, particularly under time constraints. The data also contained reports of reduced motivation and classroom engagement. M3 reported:

"Since I started using AI, my persistence in studying has decreased... I often underestimate assignments because they are easy and quick" (Interview, M3, March 6, 2026).

D3 reported:

"During discussion sessions, students are now more silent than before. Their assignments are done carelessly; what matters is that they are finished and they are less creative" (Interview, D3, April 13, 2026).

The observations also recorded differences between submitted academic work and students demonstrated ability to explain the work. During the March 4–5, 2026 academic activities, students identified as having used AI assistance in proposal writing did not pass the relevant assessment. During the March 5 penetration testing examination, one of three

students identified as having used AI assistance did not pass and was required to retake the examination.

Institutional Restriction of AI Platforms

Documentary and interview data showed that access to several AI platforms was restricted through the Poltek SSN institutional network. ChatGPT and DeepSeek were blocked on October 16, 2024. The restriction was confirmed through an interview with CSIRT staff and the 2025 Firewall Blocking Report.

Table 3. Summary of Reported and Observed Outcomes

Outcome	Evidence	Source
Increased learning flexibility	AI used to explore additional materials and obtain personalized explanations	M3, D2
Increased learning efficiency	Faster completion of academic tasks	M2, M3, M5
Reduced motivation and engagement	Reduced persistence and increased passivity during discussions	M3, D3
Differences between submitted work and demonstrated understanding	Students unable to explain submitted work; assessment retakes	Observation; D1
Institutional restriction	Blocking of ChatGPT and DeepSeek through institutional network	CSIRT interview; 2025 Firewall Blocking Report

D. Discussion

The findings show that AI use at Poltek SSN occurs in three main patterns: AI as a learning aid, AI as a substitute for cognitive processes, and AI as learning material. As a learning aid, students used AI to complete assignments, support coding and problem-solving, find references, and understand learning materials. M3 stated, *"I use AI when learning resources are limited or unavailable"* (Interview, M3, March 6, 2026), while M4 explained, *"I use AI when I need help finding references and answers"* (Interview, M4, March 6, 2026). M1 also stated, *"Its analysis feature is fast, which makes it easier for me to summarize a large amount of material"* (Interview, M1, March 4, 2026). These findings suggest that students primarily turn to AI when they need accessible, rapid, and practical learning assistance.

This pattern can be explained through Cognitive Offloading (Risko & Gilbert, 2016), in which individuals use external resources to reduce or support cognitive demands. In this study, AI functions as an external cognitive resource for searching, summarizing, explaining, and solving problems. When students remain actively involved in evaluating and processing AI-generated information, AI can support rather than replace their cognitive activity, aligning with foundational principles of active knowledge construction (Piaget & Inhelder, 1969). This finding is consistent with Chen et al (2020) and Yan et al (2024), who

highlighted the potential of AI to support personalized and adaptive learning, as well as Ulimaz et al (2024), who emphasized complementary human-AI interaction. However, this study extends these findings by showing that such use also occurs within a specialized government-affiliated institution where AI access is restricted, demonstrating that students' learning needs can persist despite institutional limitations.

A different pattern emerged when students used AI to produce substantial parts of academic tasks. Observations showed instances in which AI-generated content was incorporated into proposals and reports, while some students experienced difficulty explaining submitted work during examinations. D1 also reported that AI-assisted penetration-testing reports sometimes did not follow the required format. This observation is consistent with findings that AI-generated cybersecurity outputs still require human oversight to meet specific technical and structural standards (Temara, 2024). This pattern appears to be associated with time pressure and the convenience of obtaining immediate outputs. M2 stated, *"Due to limited time, AI enables me to complete something faster within a limited amount of time"* (Interview, M2, March 5, 2026), while M3 stated, *"Time efficiency, faster"* (Interview, M3, March 6, 2026). Thus, the same efficiency that makes AI useful as a learning aid may also encourage students to delegate core cognitive tasks to the technology.

From the Cognitive Offloading perspective (Risko & Gilbert, 2016), this represents a shift from cognitive support to cognitive substitution. The distinction is important because offloading is not inherently problematic; its educational risk emerges when students delegate the very processes they are expected to develop. This finding supports Jose et al (2025), who described the cognitive paradox of AI as a technology that can simultaneously enhance and erode cognitive engagement. It also supports Rahman et al (2024) and Kamil et al (2025), who identified concerns regarding excessive dependence on AI and reduced critical engagement. Such over-reliance effectively turns AI into a cognitive crutch, which experimental evidence suggests can hinder students' knowledge retention (Barcaui, 2025). The present study extends this literature by showing that the distinction between support and substitution becomes particularly visible in cybersecurity education, where students are expected to demonstrate technical reasoning and explain their procedures rather than merely submit completed products.

The findings also show that AI is positioned as learning material through its inclusion in the Poltek SSN curriculum. This demonstrates that AI has a dual role: it is both a technology used by students and knowledge that students are expected to master. This finding is consistent with Liang et al (2025), who identified the growing influence of AI on higher education curriculum, instruction, and assessment, and with Altukhi & Pradhan (2024), who emphasized the importance of developing students' competence in emerging AI technologies. In the context of Poltek SSN, however, these findings reveal a distinctive institutional paradox: AI is simultaneously a technology to be learned, a tool for learning, and a technology subject to restriction.

The second research question concerns why students continue to use AI despite institutional restrictions. The findings identify four main reasons: cognitive support, limited

learning resources, time constraints, and AI's accessibility, speed, responsiveness, and contextual accuracy. M3 stated, *"I use AI when I am unable to solve a problem myself"* (Interview, M3, March 6, 2026). These factors suggest that institutional restrictions do not eliminate the practical conditions that motivate students to seek AI assistance. Rather, students continue to use AI because it addresses immediate learning and task-related needs. This finding suggests that restrictions alone may not sufficiently address the underlying reasons for AI use.

Overall, this study extends the literature by connecting Cognitive Offloading with Educational Technology and institutional AI governance. The findings show that the educational value of AI depends less on whether students use AI than on how and why they use it. AI can enhance flexibility and efficiency when functioning as learning support, but excessive reliance may reduce cognitive engagement and obscure students' actual learning. Therefore, the findings answer the first research question by identifying three main patterns of AI use and answer the second by showing that students continue to use AI because of cognitive, resource, time, and technological needs. These findings support a shift from purely restrictive policies toward structured AI use that preserves students' cognitive responsibility.

E. Implication

This study has theoretical and practical implications for the integration of AI in higher education. Theoretically, the findings reinforce the relevance of Cognitive Offloading in explaining how AI can function either as cognitive support or as a substitute for students' cognitive processes, depending on how it is used. From an Educational Technology perspective, AI should therefore be positioned as a learning aid that supports students' analysis, problem-solving, and knowledge construction while preserving their cognitive responsibility. Practically, lecturers should design AI-integrated learning and assessment activities that require students to demonstrate their understanding through explanation, oral presentation, simulation, or other process-based assessments. For students, strengthening AI literacy and academic integrity is essential to ensure responsible use. At the institutional level, Poltek SSN should develop clear and proportionate AI-use guidelines, strengthen AI literacy, and integrate AI strategically into learning and assessment rather than relying solely on access restrictions. These measures can help maximize the benefits of AI while minimizing risks to students' cognitive engagement, learning autonomy, and academic integrity.

F. Limitation and Suggestion for Further Research

This study has several limitations. First, the exploratory single-case design provides an in-depth understanding of AI use within the specific institutional context of Poltek SSN but limits the transferability of the findings to other higher education institutions. The findings are contextual and reflect the learning practices, institutional conditions, and

experiences of participants during the research period. In addition, AI technologies and patterns of use continue to develop rapidly, while some participants may not have fully disclosed sensitive experiences related to AI use and academic integrity.

Future research should conduct comparative studies across higher education institutions with different disciplines, institutional characteristics, and AI governance approaches to examine similarities and differences in AI use. Mixed-methods studies are also recommended to complement qualitative findings with quantitative evidence regarding the prevalence, frequency, and effects of AI use on learning outcomes, academic integrity, and learning behaviors. Longitudinal research would further be valuable for examining changes in students' AI use, cognitive reliance, learning practices, and institutional policies as AI technologies and educational regulations continue to evolve.

G. Conclusion

This study concludes that AI use in learning at Poltek SSN occurs through three main patterns: AI as a learning aid, AI as a substitute for cognitive processes, and AI as learning material. Students use AI primarily because of the need for cognitive support, limited learning resources, time constraints, and its accessibility, speed, responsiveness, and contextual accuracy. While AI provides greater learning flexibility and efficiency, excessive reliance may reduce cognitive engagement, motivation, and the quality and authenticity of learning outcomes. The findings indicate that institutional restrictions alone are insufficient to address these challenges because students continue to experience practical learning needs that encourage AI use. Therefore, responsible AI governance should move beyond prohibition toward structured and proportionate AI integration through AI literacy, clear guidelines, and learning and assessment practices that preserve students' cognitive responsibility, learning autonomy, and academic integrity.

References

- Altukhi, Z. M., & Pradhan, S. (2024). Systematic Literature Review: Explainable AI Definitions and Challenges in Education. *45th International Conference on Information Systems, ICIS 2024*, 1–17. <https://doi.org/10.48550/arXiv.2504.02910>
- Apriadi, R. T., & Sihotang, H. (2023). Transformasi Mendalam Pendidikan melalui Kecerdasan Buatan: Dampak Positif bagi Siswa dalam Era Digital. *Jurnal Pendidikan Tambusai*, 7(3), 31742–31748.
- Barcaui, A. (2025). ChatGPT as a Cognitive Crutch: Evidence from a Randomized Controlled Trial on Knowledge Retention. *Social Sciences and Humanities Open*, 12, Article 102287. <https://doi.org/10.1016/j.ssaho.2025.102287>
- Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education: A Review. *IEEE Access*, 8, 75264–75278. <https://doi.org/10.1109/ACCESS.2020.2988510>

- Creswell, J. W., & Poth, C. N. (2018). *Qualitative Inquiry and Research Design: Choosing among Five Approaches* (4th ed.). Sage Publications. <https://www.sagepub.com/en-us/cab/qualitative-inquiry-and-research-design/book246896>
- Garzón, J., Patiño, E., & Marulanda, C. (2025). Systematic Review of Artificial Intelligence in Education: Trends, Benefits, and Challenges. *Multimodal Technologies and Interaction*, 9(8), 84. <https://doi.org/10.3390/mti9080084>
- Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial Intelligence in Education: Promises and Implications for Teaching and Learning*. Center for Curriculum Redesign. Retrieved from <https://curriculumredesign.org/our-work/artificial-intelligence-in-education/>
- Holmes, W., & Porayska-Pomsta, K. (Eds.). (2022). *The Ethics of Artificial Intelligence in Education: Practices, Challenges, and Debates*. Routledge. <https://doi.org/10.4324/9780429329067>
- Holmes, W., & Tuomi, I. (2022). State of the Art and Practice in AI in Education. *European Journal of Education*, 57(4), 542–570. <https://doi.org/10.1111/ejed.12533>
- Januszewski, A., & Molenda, M. (2008). *Educational Technology: A Definition with Commentary*. Lawrence Erlbaum Associates. <https://doi.org/10.4324/9780203054000>
- Jin, S. H., Im, K., Yoo, M., Roll, I., & Seo, K. (2023). Supporting Students' Self-Regulated Learning in Online Learning Using Artificial Intelligence Applications. *International Journal of Educational Technology in Higher Education*, 20(1). <https://doi.org/10.1186/s41239-023-00406-5>
- Jose, B., Cherian, J., Verghis, A. M., Varghise, S. M., S, M., & Joseph, S. (2025). The Cognitive Paradox of AI in Education: Between Enhancement and Erosion. *Frontiers in Psychology*, 16. <https://doi.org/10.3389/fpsyg.2025.1550621>
- Kamil, I., Miranda, T., & Setiawan, A. R. (2025). Pengaruh Kecerdasan Buatan (Artificial Intelligence) terhadap Mahasiswa di Perguruan Tinggi. *JEDBUS: Journal of Economic and Digital Business*, 2(1), 33–41.
- Liang, J., Stephens, J. M., & Brown, G. T. L. (2025). A Systematic Review of the Early Impact of Artificial Intelligence on Higher Education Curriculum, Instruction, and Assessment. *Frontiers in Education*, 10. <https://doi.org/10.3389/feduc.2025.1522841>
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic Inquiry*. Sage Publications.
- Lubguban, N. S., Jr., & Bauyot, M. M. (2025). Utilizing Artificial Intelligence for Education 4.0 and Beyond: A Systematic Review. *Asian Journal of Education and Social Studies*, 51(6), 162–183. <https://doi.org/10.9734/ajess/2025/v51i61985>
- Melo-López, V. A., Basantes-Andrade, A., Gudiño-Mejía, C. B., & Hernández-Martínez, E. (2025). The Impact of Artificial Intelligence on Inclusive Education: A Systematic Review. *Education Sciences*, 15(5). <https://doi.org/10.3390/educsci15050539>

- Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative Data Analysis: A Methods Sourcebook*. Sage Publications
- Patnaik, S., & Paas, F. (Eds.). (2023). *Recent Trends in Educational Technology and Administration*. Springer. <https://doi.org/10.1007/978-3-031-29016-9>
- Piaget, J., & Inhelder, B. (1969). *The Psychology of the Child*. Basic Books.
- Rahman, P., Ningsih, N., & Rahim, A. (2024). Potensi Ancaman Kecerdasan Buatan bagi Perguruan Tinggi. *El-Idarah: Jurnal Manajemen Pendidikan Islam*, 10(1), 63–72.
- Risko, E. F., & Gilbert, S. J. (2016). Cognitive Offloading. *Trends in Cognitive Sciences*, 20(9), 676–688. <https://doi.org/10.1016/j.tics.2016.07.002>
- Schunk, D. H., & Zimmerman, B. J. (Eds.). (2012). *Motivation and Self-Regulated Learning: Theory, Research, and Applications*. Routledge.
- Temara, S. (2024). Maximizing Penetration Testing Success with Effective Reconnaissance Techniques Using ChatGPT. *Asian Journal of Research in Computer Science*, 17(5), 19–29. <https://doi.org/10.9734/ajrcos/2024/v17i5435>
- Ulimaz, A., Cahyono, D., Dhaniswara, E., Arifudin, O., & Agus Rukiyanto, B. (2024). Analisis Dampak Kolaborasi Pemanfaatan Artificial Intelligences (AI) dan Kecerdasan Manusia terhadap Dunia Pendidikan di Indonesia. *Innovative: Journal of Social Science Research*, 4(3), 9312–9319. <https://doi.org/10.31004/innovative.v4i3.11544>
- Yan, L., Sha, L., Zhao, L., Li, Y., Martinez-Maldonado, R., Chen, G., Li, X., Jin, Y., & Gašević, D. (2024). Practical and Ethical Challenges of Large Language Models in Education: A Systematic Scoping Review. *British Journal of Educational Technology*, 55(1), 90–112. <https://doi.org/10.1111/bjet.13370>
- Yin, R. K. (2018). *Case Study Research and Applications: Design and Methods* (6th ed.). Sage Publications. <https://uk.sagepub.com/en-gb/eur/case-study-research-and-applications/book250150>
- Yusuf, F. A. (2025). Trends, Advantages, and Challenges: A Systematic Literature Review of Artificial Intelligence in Design Education. *Journal of Educational and Social Research*, 15(4), 401–417. <https://doi.org/10.36941/jesr-2025-0147>

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