Cognitive Leap or Digital Divide? A Comparative Study on AI-Driven Learning and Student Analytical Capacity in Samarinda and Aceh

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Abstract: Cognitive Leap or Digital Divide? A Comparative Study on AI-Driven Learning and Student Analytical Capacity in Samarinda and Aceh. **Objective:** The purpose of this study is to investigate the impact of artificial intelligence (AI) on teaching methods on students' analytical thinking abilities in Aceh and Samarinda, two distinct regions of Indonesia. This study explores whether AI functions as a reflective cognitive stimulant or simply as a way to speed up students' assignments. **Method:** This study employed a descriptive qualitative analysis, utilizing data collection methods such as semi-structured interviews with 80 participants, comprising 20 teachers and 60 high school students from Aceh and Samarinda. In addition, analytical tools such as NVivo 14 also supported the data management process, such as selective, axial, and open coding. Purposive sampling was used to select participants representing diverse educational environments and varying digital literacy levels. Through researcher triangulation, peer debriefing, and member checking, thematic saturation was ensured, and rigor was upheld. **Findings:** The results show significant regional variations in the use of AI. AI is utilized as a tool for introspection, argument construction, and investigation of various viewpoints in Samarinda, where educators demonstrate higher levels of digital and pedagogical literacy. Students actively utilize ChatGPT and related sites to develop their critical thinking skills. On the other hand, due to a lack of teacher supervision and limited exposure to technology, AI is primarily used in Aceh to automate tasks with minimal critical engagement. Students often turn to AI for quick responses, which can hinder their ability to think critically and develop their analytical skills. **Conclusion:** This study concluded that the quality of teacher mediation and the pedagogical context have a greater influence on students' analytical abilities than access to technology. Reflective learning techniques, teacher digital competence, and an educational culture that prioritizes critical thinking over task completion are all necessary for effective AI integration.

Keywords: artificial intelligence, analytical thinking, teacher literacy, digital education, ChatGPT, pedagogical approach.

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◼ INTRODUCTION

The acceleration of information and communication technology has had a significant impact on education worldwide. Artificial Intelligence (AI) is the most advanced and innovative innovation integrated into formal and informal education systems (Holmes, Bialik, & Fadel, 2019; Luckin & Holmes, 2016). AI is a transformative force that can enable independent, interactive, and adaptive learning (Mohammed et al., 2024). According to Chiu (2024), ChatGPT and other intelligent devices have the ability to act as thinking partners that help students develop critical and reflective thinking skills.

According to Xia, Weng, & Ouyang (2024), Artificial Intelligence is capable of performing tasks involving reasoning, learning, and high correction power. In terms of education, this technology can make a fundamental shift in the pedagogical paradigm, especially by enabling access to feedback and enabling independent learning. Research by Wang et al. (2025) shows that when embedded properly into pedagogy, AI platforms can assist students in evaluating arguments and constructing complex ideas. AI in education is still a relatively new concept in Indonesia, and it tends to develop asymmetrically, with better-infrastructured regions adopting it first. It is hoped that the findings of this study will not only be relevant to the Indonesian context but also contribute to global discussions. Aceh, a province located at Indonesia's westernmost tip, and Samarinda, a city in East Kalimantan, are representative of two regions with distinct social, cultural, and educational infrastructure features. Although both began to apply AI technology in the high school environment, the critical question that arises is whether and how AI actually impacts the improvement of students' analytical power equally in these two regions (Samarinda City and Aceh)?.

Furthermore, recent research by Rachbauer et al. (2024) & Melisa et al. (2025) highlights that the teacher's function as a mediator or guide plays a major role in how well AI enhances critical thinking. A key Vygotskian idea in mediating learning processes, particularly when new technologies are involved, is the role of teachers as the More Knowledgeable Other (MKO) (Royer, 2024). Vygotsky's sociocultural theory (1978) holds that social interaction and mediated learning are the foundations of cognitive development. According to this framework, artificial intelligence (AI) can be seen as a potent mediating tool that enhances higher mental functions, especially when teachers scaffold its use through dialogic learning and reflective questioning. However, the degree of digital and pedagogical literacy possessed by teachers determines the quality of this mediation (Vygotsky& Cole, 1978). Without such scaffolding, AI risks becoming an automation shortcut rather than a reflective learning partner (Munir et al., 2022). As emphasized by Yang et al. (2025), merely providing access to AI without guidance may widen the gap between higher-order thinking skills and passive consumption of information. Analytical thinking emerges when students actively participate in their education through investigation, debate, introspection, and engagement with the classroom, according to constructivist learning theory (Piaget, 2013; Vygotsky & Cole, 1978; Walter, 2024). This constructivist framework is thought to be supported by AI's capacity for simulation, logical reasoning, and automated feedback (Luckin & Holmes, 2016). Nevertheless, there is currently little empirical and analytical research addressing the spatial and sociopedagogical gaps in the application of AI in Indonesian regions. According to research by Hapsari et al. (2024), nearly 80% of respondents concur that using AI applications can enhance learning outcomes and student motivation.

A Study by Ulla et al. (2024) reveals that AI can significantly increase students' learning motivation and is effective in an online learning model based on Google Classroom (Ulla et al., 2024). Another critical view is the application of AI in a study on the dark side of technology, how AI can affect student motivation from Tülübaº et al. (2023), which states that severe or continuous dependence can result in addiction, which actually has a negative impact on students' analytical abilities in learning at school, and this will impact student motivation in their learning. The authors argue that students can become weak in critical thinking and tend to be perceived as lazy or less motivated in learning due to the ease of access to information and the ability of AI to complete

assignments. Furthermore, a study by Royer (2024) shows that excessive use of AI can hinder thinking patterns in students' intelligence and reduce students' creativity in the learning process. These studies show that some students feel that dependence on AI can reduce their analytical and critical thinking skills. In a case like Indonesia, the application of AI is still higher in areas with more advanced infrastructure than in areas with minimal infrastructure, because teachers often struggle to access it. This condition will also affect teachers' and students' literacy, particularly in terms of low digital literacy. Several national and international studies (e.g., Maola et al., 2024; Hapsari et al., 2024; Bulathwela et al., 2024) stated that, however, global discourse is starting to highlight the cognitive risks of excessive reliance on AI. AI tends to be used for efficiency rather than cognitive stimulation. Ülübaº et al. (2023) and the MIT Media Lab (2025) warn that critical student engagement will decline (Mishra & Koehler, 2006). Furthermore, a generation of students supported by thinking machines rather than independent critical thinking is a major mistake and something that needs to be warned to the world (O'Connor & Aloisi, 2025). Even though the amount of research on the effects of teacher-mediated AI use on students' cognition is increasing, there is still a sizable empirical research gap, especially in understudied countries like Indonesia. This study aims to close this gap by examining separate cases in Aceh and Samarinda. This study specifically aims to explore a new type of digital divide known as the "pedagogical-digital literacy gap," which refers to teachers' ability to use technology pedagogically to enhance the quality of instruction. Thus, this research aims to respond to the following query: First, how is AI being utilized in the learning process in Samarinda and Aceh? Second, what is the impact of AI use on students' analytical thinking skills in the two regions? Third, is there a significant difference in AI literacy between students and teachers in Samarinda and Aceh? Fourth, how do students and teachers perceive artificial intelligence in improving critical and analytical thinking? Moreover, does the use of AI in education have the potential to narrow or widen the digital divide between regions?

■ **METHOD**

The perceptions, experiences, and effects of AI use on students' analytical abilities are thoroughly examined in this study using a descriptive qualitative methodology. Because it allows for the examination of the significance of how teachers and students interact with technology in a contextual, subjective, and reflective manner, this method is regarded as pertinent. NVivo 14 software, which organizes and categorizes the interview data in a methodical way, is used to support the thematic analysis process. In-depth interviews with 60 students and 20 teachers in the cities of Samarinda and Aceh were used to gather data. After that, the data were openly coded to reveal important themes about AI use and its impact on students' capacity for critical thinking. Additionally, axial coding is used to link themes, and *selective coding* to formulate the pattern and thematic meaning in its entirety.

Participant

A total of 80 people participated in this study, including 20 teachers (10 from each city) and 60 high school students (30 from Aceh and 30 from Samarinda). Purposive sampling was used to select participants who met the research criteria, including teachers who had worked with or mentored students in AI-based learning contexts, and students who had utilized AI tools (such as ChatGPT) in school-related tasks. The chosen schools represented the urban public high school population in both regions and differed in terms of infrastructure and type.

No	Research Focus	Main Code	Number of References (Codes)	Number of Respondents
1	AI as a Stimulant for Analytical Power	Reflection, logic, exploration	46	30 students from Samarinda
2	AI as a Rapid Automation Tool	Copy-paste, instant answers, lazy thinking	39	30 Acehnese students
3	Teacher Literacy on the Use of AI	AI guidance, instruction, discussion	24	20 teachers in Aceh and in Samarinda

Research Design and Procedures

Researchers will explicitly analyze how teachers and students view and think about the use of AI in the classroom. This study uses a descriptive qualitative design carried out in several stages, starting between November 2024 and March 2025. This stage includes several things; the first is coordinating with schools and obtaining approval from the Institution. The second stage involves inviting participants, including students and teachers, to sign an agreement to participate in this research. The third stage involves conducting semi-structured interviews with each participant separately, and the fourth stage involves conducting audio recordings and transcribing these interviews. The fifth stage, conducting thematic analysis assisted by NVivo14 software (open, axial, and selective coding). The sixth stage, peer debriefing and checking to ensure the accuracy of the data in the research results. This design method was used to explore positive and contextual trends in the application of AI in both social and educational settings.

Instrument

The instrument in this semi-structured interview guide was developed and modified based on international studies on AI in Education, and will serve as the primary instrument for future data collection (Chiu, 2024; Melisa et al., 2025). The instrument was tested on a small group of teachers and students who were not part of the primary sample, after being analyzed and evaluated by two experts in qualitative education research to ensure its validity. With the permission of the participants, data were recorded using digital audio devices during the 30 to 45-minute interviews. In order to record contextual information, field notes were also taken both during and after the interviews. The researchers posed the following queries:

Sample questions for students included:
a. "Can you describe your experience using ChatGPT for a specific assignment?"
b. "What follow-up questions did you ask after receiving the initial AI response?"
c. "How did you verify that the AI answer was correct or appropriate?"

Sample questions for teachers included:
a. "How do you design assignments involving AI tools like ChatGPT?"
b. "How do you assess the originality of student work when AI is involved?"

Data Analysis

NVivo 14 software was used to support a thematic analysis approach to data analysis. Three coding levels were used for this. Open coding comes first. Preliminary extraction of important ideas from the data; Axial coding comes in second. Linking form categories to related codes; third, selective coding. Combining categories to create central ideas. The number of text segments (phrases, sentences, or paragraphs) that were tagged under a particular theme in NVivo is

known as the "Number of References (Codes)" and is used to describe the coding results. For instance, "I compare the AI answer with my textbook" could be classified as reflective or analytical thinking. To show the breadth and regularity of participant responses under each theme, these references were methodically tallied. Two separate researchers coded to ensure reliability. The percentage agreement used to evaluate inter-coder reliability was 87%, indicating high consistency. Peer debriefing was used to discuss and settle interpretational disagreements. The study employed several techniques based on Lincoln & Guba's (1994) framework, including credibility, transferability, dependability, and confirmability, to ensure rigor and reliability. These actions improved the research process's validity and openness. The objectives and methods of the study were thoroughly explained to all participants, including teachers and students. Adult participants, as well as students, and their parents or legal guardians, voluntarily signed an informed consent form.

Pseudonyms were used to anonymize participant identities, and all information was safely stored. Neither the analysis nor the reporting revealed any personally identifiable information. The researchers are academics or lecturers in educational management who have expertise in reflective learning methodologies and AI-related pedagogy. Although the researchers were not directly involved in the schools under investigation, their experience as teachers in comparable settings facilitated the interpretation of participants' experiences. In order to reduce bias and respect participant viewpoints, reflexivity was upheld throughout the data collection and analysis process.

RESULT AND DISCUSSION

AI as a Reflective and Exploratory Stimulato in Strengthening Students' Analytical Power

The NVivo analysis's initial thematic findings demonstrate that artificial intelligence (AI) can encourage students to think critically and exploratorily during the learning process. Most students who responded, particularly those in Samarinda City, acknowledged that ChatGPT and AI tutors are more than just instant answers; they are also tools that stimulate curiosity and develop critical thinking skills. This is reflected in one of the quotes from a student at SMAN in Samarinda:

"I like to ask ChatGPT again, why is the answer like that, and I continue to compare it with my opinion." Therefore, it is not just about getting answers, in my opinion. (NVCode_11, SMAN Samarinda students).

This quotation characterizes the metacognitive approach's self-inquiry or self-questioning process. The ability to recognize, regulate, and assess one's own thought processes is known as metacognition in the context of learning. In this instance, AI serves as a catalyst for the process by offering a response that the student can contest. Strong analytical power is built on the patterns of internal dialogue that are fostered by this. Additionally, students can use AI's exploratory function to not only comprehend the content from a single perspective but also to compare and contrast different analyses and even look for confirmation from other sources. This exploratory experience is crucial for developing a scientific and argumentative mindset that relies on cause-and-effect reasoning, logic-based comprehension, and information synthesis in addition to memorization. This method is consistent with social constructivism, which holds that learning happens when people actively create meaning through their interactions with the outside world, including technology. AI is incorporated into an interactive learning environment where students actively challenge, contrast, and form their own opinions rather than passively accepting them. According to NVivo 14's open coding and axial coding results, the terms "thinking stimulator" and "self-reflection tool" were consistently found

in the majority of Samarinda student transcripts. This demonstrates that the role of AI extends beyond its technical application (information access) to a higher cognitive level, specifically the assessment and revision of understanding. These results also indicate a shift in education from a teacher-centered to a learner-centered approach, where students have greater control over how their education is guided. AI enables students to actively formulate questions, consider multiple answers, and create their own conceptual frameworks rather than passively waiting for guidance from the instructor. A learning agency the self-awareness to take responsibility for the learning process and results is fostered by this process.

The categories of "independent thinking" and "reinforcement of argument analysis" are highly correlated, according to the axial coding analysis. AI encourages students to evaluate an argument's logic rather than merely searching for the correct or incorrect response. Given that students are encouraged to cross-check, compare references, and challenge presumptions, this demonstrates how AI has the potential to increase the space for analytical thinking. Additionally, a few students disclosed that AI prompts them to formulate follow-up questions based on the content covered in class. This indicates growth in the field of informal learning, accompanied by high cognitive engagement. Students can access learning materials and analysis exercises at any time, thanks to AI, which creates a learning ecosystem that is not restricted by time or classrooms. This is because learning materials and analysis tasks are available to students whenever they need them. According to the teachers surveyed, AI is a collaborator in the educational process.

"They are usually better prepared with arguments if they ask ChatGPT first before a class discussion," stated an Acehnese teacher.

Thus, the conversation is more animated. (High school instructor in Aceh, NVCode_27).

This claim demonstrates how active AI use promotes discussion readiness for critical thinking, which improves classroom dynamics. AI enhances its role as a thinking facilitator rather than taking the place of educators. However, not every student can utilize AI in a thoughtful manner. Some students only use AI to get quick answers without giving them much thought, especially those who learn best passively. This demonstrates that the effectiveness of using AI to boost analytical power is significantly influenced by digital literacy and metacognitive literacy. As a result, training in thinking literacy and academic ethics must be integrated with the use of AI in education.

These results can also be linked to the updated Bloom's Taxonomy concept (Anderson & Krathwohl, 2001; Conklin, 2005), which emphasizes high-level thinking skills, such as analyzing, evaluating, and creating, as the primary objectives of contemporary education. As long as AI is applied thoughtfully, critically, and strategically, it can actually help students get to that level. Therefore, it is important to stress that AI is a pedagogical tool that facilitates the growth of reflective, logical, and argumentative thought processes in addition to being a technical tool. Because of this, educational institutions and educators must incorporate AI into a learning system that focuses on higher-order thinking skills (HOTS) rather than just basic cognitive learning objectives.

According to Graph 1's explanation, "Understanding complex concepts" has a 40% dominance. This suggests that rather than merely using AI to find answers, students primarily use it as a tool to help them understand concepts. This demonstrates growth in metacognition, or the ability of students to recognize their own mental processes when engaging with AI. Some students utilize AI to consider multiple perspectives and
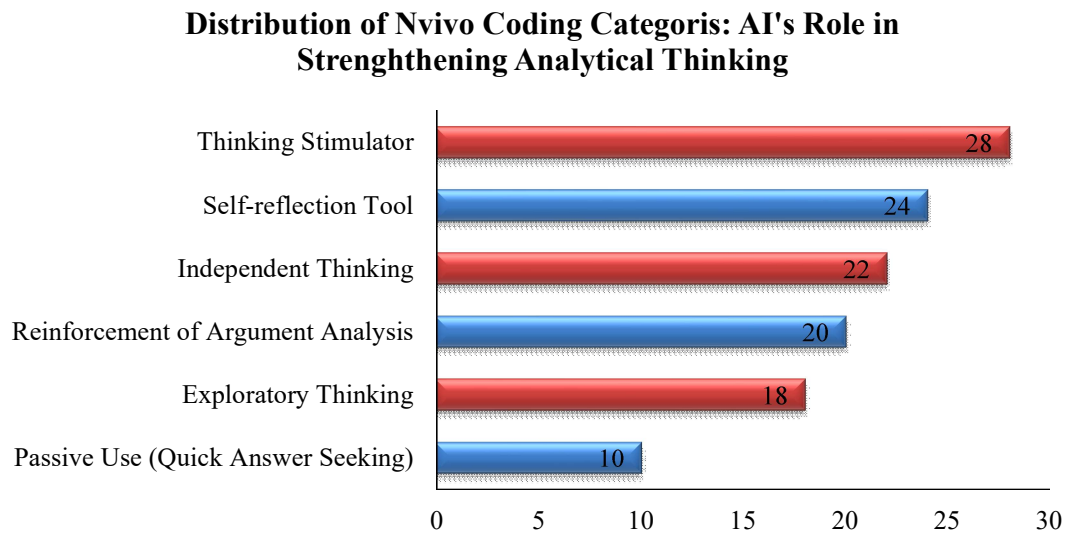
Distribution of Nvivo Coding Categoris: AI's Role in Strenghthening Analytical Thinking

Category	Value
Thinking Stimulator	28
Self-reflection Tool	24
Independent Thinking	22
Reinforcement of Argument Analysis	20
Exploratory Thinking	18
Passive Use (Quick Answer Seeking)	10

Figure 1. AI's role in strengthening analytical thinking
Source: NVIVO14, 2025.

form logical assessments of information, as evidenced by their scores in "Comparing different perspectives" (25%) and "Evaluating arguments" (15%). This demonstrates how AI can support critical and analytical thinking, even though few students are able to do so. In contrast, 10% is a relatively low percentage in the "Exploring new ideas" category. This indicates that a small percentage of students are applying AI in creative ways, due to low curriculum or teacher support for exploration. Finally, 10% in the other categories show a variety of unexplored applications such as entertainment, translation, or avoidable misuse. It is clear that while AI can help students develop their analytical skills, its effectiveness still depends on pedagogical interventions. This graph indicates that the majority of students utilize AI to assess their understanding, with the goal of discovering alternative perspectives or honing their analytical skills. This result suggests that AI can indeed function as a friend or companion in critical thinking and encourage them to digest difficult-to-analyze information. However, there are regional disparities in the application of AI analytics. While

this graph demonstrates the effective use of AI, it can be seen as a sign of cognitive gaps created by external circumstances. This is supported by Chiu's (2024) research and thinking, which states that if AI is applied in an area that encourages investigation and inquiry rather than just information and consumption, AI can stimulate critical thinking. This further strengthens the thinking of Melisa et al. (2025) that AI can expand and consciously enhance students' metacognitive awareness. This result is consistent with other international literature that shows that AI can encourage students' high-level thinking processes and analytical abilities, as well as reflective and strategic metacognition (Melisa et al., 2025; Xia, Weng, & Ouyang, 2024; Chiu, 2024). AI is not just a provider of information; it can act as a creative thinking partner in analyzing arguments, as emphasized by Chiu (2024).

AI as a Rapid Automation Tool: A Threat to Cognitive Engagement

In contrast to the findings in Samarinda, data from in-depth interviews with Acehnese students showed a tendency to use AI as a quick

fix to finish schoolwork without sufficient cognitive engagement. In this case, AI is positioned more as a quick-reaction machine than as a companion for introspective thought. One Acehnese high school student stated:

"If I just ask for homework answers, it is quick; teachers sometimes do not ask in detail whether we know or not." (Students of SMAN Aceh, NVCode_24).

This quotation clearly illustrates how some students use AI in a mechanical and automatic manner, without engaging in the corresponding critical thinking process, instead of applying it to gain a deeper understanding. This use model has the effect of decreasing the power of analysis because students become used to receiving answers without assessment, evaluation, or confirmation. The NVivo coding results showed that Acehnese students' responses were dominated by categories such as "quick answers," "task aids," and "thought substitutes." The results of axial coding then showed a strong correlation between immediate AI use and poor active participation in class discussions, reliance on machines to complete necessary tasks, and low motivation to learn deeply.

This phenomenon confirms the concerns of many educators regarding the potential unintended consequences of technology, including artificial intelligence. On the one hand, AI could expedite information access and support personalized learning. However, if there is no framework for learning ethics and no instruction on how to use it appropriately, AI may actually impair students' capacity for reasoning. As Selwyn (2021) points out, educational technology is never neutral; rather, its effectiveness depends on how it is integrated into the curriculum and the level of digital literacy among the students. Teachers' lack of pedagogical supervision and reflection further supports Aceh's surface-level approach to AI usage. Many educators expressed difficulty in monitoring the authenticity of their students' assignments or assessing whether they actually understood the content they were working on, particularly when using AI.

Students who rely too heavily on AI as a short-term solution run the risk of developing a permissive mindset in which they place greater value on the final product than on the learning process. This is contrary to the purpose of education, which is to foster conceptual understanding, logical reasoning, and intellectual independence. This behavior could hinder students' development of academic integrity and a scientific mindset if left unchecked. Therefore, these results highlight the need for teachers, schools, and educational institutions to implement strategic interventions. Instill technology ethics and critical thinking abilities. Instead of only developing end-product-based evaluation systems, develop process-based ones. Make students more conscious of the long-term effects of an unwarranted reliance on technology. AI must be used as a learning tool in conjunction with a values-based pedagogical approach and cognitive awareness. Technology should be utilized as a learning tool that promotes logical thinking rather than as a shortcut to complete a task. The qualitative findings of the study show that how students in Aceh and Samarinda City use AI differs significantly. While Samarinda students use AI more frequently as a tool for introspection and knowledge exploration, Acehnese students usually use it for pragmatic purposes only, such as completing assignments quickly without exercising critical thought. This tendency is reflected in one of the Acehnese students' statements:

"If I just ask for homework answers, it is quick; teachers sometimes do not ask in detail whether we know or not." (Students of SMAN Aceh, NVCode_24).
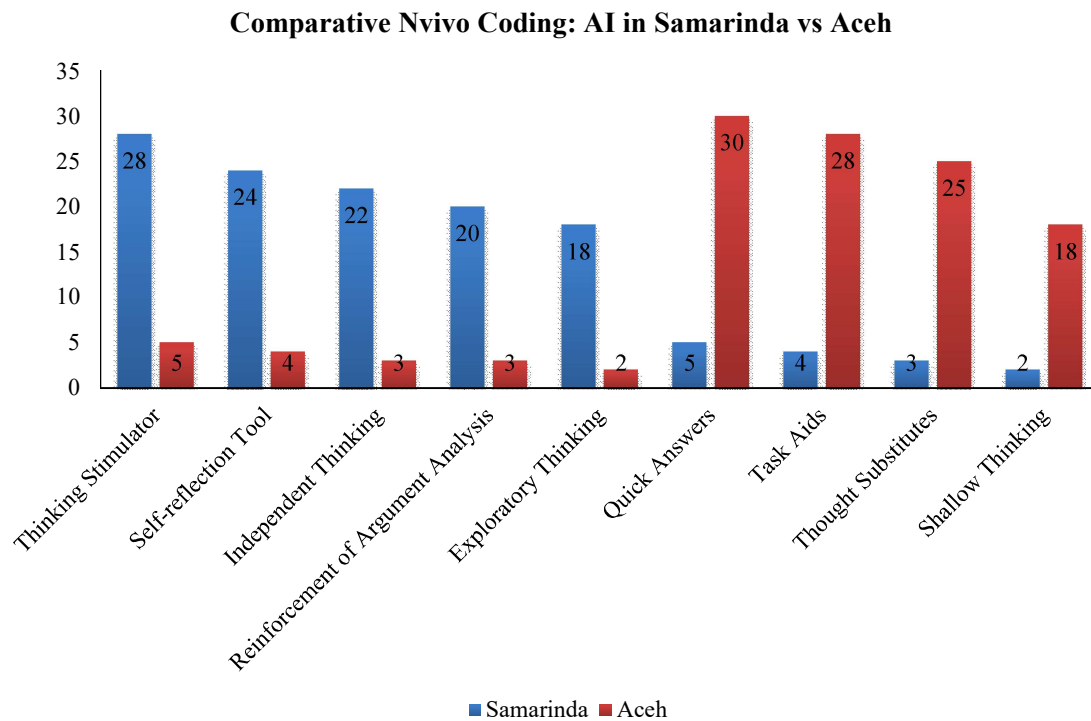
Comparative Nvivo Coding: AI in Samarinda vs Aceh

Figure 2. AI's use in samarinda and aceh
Source: NVIVO14, 2025

The usage patterns of AI in Aceh and Samarinda differ significantly, as seen in Graph 2. In Aceh, artificial intelligence is primarily used for short-term tasks, such as copying responses or summarizing content, whereas in Samarinda, it is utilized for idea exploration, reflection, and analysis. The fact that "Reflective learning" is so prevalent in Samarinda (45%) suggests that students there use AI to develop their critical thinking, argumentation, and comprehension. This is not a coincidence; rather, it is the outcome of a learning ecosystem that is bolstered by highly literate teachers and methods that encourage experimentation. The "Quick answers" category, on the other hand, is most prevalent in Aceh (55%), indicating a shallow and functional approach to AI use that focuses on completing quick tasks without requiring deep cognitive engagement.

This is an example of what Carr (2010) refers to as "shallow thinking." In Aceh, only 5% of the population falls into the "Exploring ideas"

and "Argument evaluation" categories. This implies that students there are not accustomed to using AI for higher-order thinking tasks, such as idea generation or argument analysis. This is probably the result of either a lack of critical thinking instruction or unclear direction from teachers. The high percentage of students in Aceh who fall into the "Other" category (25%) may suggest that many of them are using AI for non-academic purposes (like entertainment, chatting, and even plagiarism). For educators, this might be a warning sign. Specifically focusing on "Quick Answers" categories, what makes them so popular in Aceh? Low digital is the solution and the minimal role of teachers as facilitators of reflective learning. In this case, artificial intelligence (AI) substitutes instant processing devices for cognitive learning tools, depriving students of the capacity for critical thought, logical reasoning, and conceptual reflection. NVivo's open coding data indicates that most Acehnese students value technical efficiency over learning

depth. The use of terms like "quick," "direct answer," and "practical" in interview transcripts indicates that they saw AI as an academic shortcut rather than a thinking partner.

One consequence of this pattern is a decrease in active cognitive engagement. If students are accustomed to completing assignments by copying and pasting from AI, they will eventually struggle to formulate arguments, assess the credibility of information, and engage in critical thinking. This could lead to a generation of passive learners who rely more on machines than on their own critical thinking abilities. This inequality can also be explained by Vygotsky's sociocultural approach, which focuses on how social, cultural, and mediating interactions, including technology, have an effect on people's cognitive development (Vygotsky & Cole, 1978). Students at Samarinda are utilizing AI to enhance their thought processes due to the school's culture of reflective learning, open communication with teachers, and increased technological exposure. However, there are indications that AI is being used passively in Aceh due to a lack of guidance, a teaching style that is not yet revolutionary, and a limited understanding of AI as a teaching tool. In this case, teachers play a crucial role. Without sufficient control over the learning process, teachers who lack a technologically adaptive pedagogical understanding frequently allow students to use AI freely. In reality, if AI is not properly contextualized within the framework of curriculum and teaching strategies, it will reinforce superficial and uncritical learning practices (Yilmaz et al., 2024).

Carr (2010) criticizes shallow learning, which involves the use of technology that solely seeks immediate results without a deliberate process, and the pattern of "quick answer" use reflects this. According to O'Connor (2025) and Aloisi (2025), Aceh is a prime example of how the younger generation is beginning to perceive AI as a "task-solving machine" rather than a thought partner. This disparity further supports the idea of the "pedagogical digital divide," which refers to the difference in thinking and learning styles brought about by unequal guidance, in addition to the gap in access (Celik, 2023). These results are not universal; however, the majority of students in Aceh only use AI as a task automation tool. They frequently use this technology to complete their assignments quickly, without fully reflecting on or comprehending the material. This usage pattern is indicative of what Carr (2010) refers to as "shallow thinking," which occurs when students are diverted from the process of deep thinking by technology in order to achieve immediate results. O'Connor's (2025) & Aloisi's (2025) research support these findings by cautioning that younger generations are beginning to use AI without a critical understanding in order to complete tasks more quickly. Indeed, a neuroscience-based study from the MIT Media Lab (2025) demonstrates that passive AI use has a negative effect on brain activity associated with creativity and problem-solving (Mishra & Koehler, 2006).

The quote encapsulates a phenomenon that Carr (2010) refers to as "shallow thinking," or a shallow mindset brought on by the ease of use of technology. In this case, artificial intelligence (AI) substitutes instant processing devices for cognitive learning tools, depriving students of the capacity for critical thought, logical reasoning, and conceptual reflection. NVivo's open coding data indicates that most Acehnese students value technical efficiency over learning depth. The use of terms like "quick," "direct answer," and "practical" in interview transcripts indicates that they saw AI as an academic shortcut rather than a thinking partner.

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However, there are indications that AI is being used passively in Aceh because of a lack of guidance, a teaching style that is not yet revolutionary, and a lack of knowledge about AI as a teaching tool. In this case, teachers play a crucial role. Without sufficient control over the learning process, teachers who lack a technologically adaptive pedagogical understanding often allow students to use AI freely. In reality, if AI is not properly contextualized within the framework of curriculum and teaching strategies, it will reinforce superficial and uncritical learning practices.

Teacher Literacy as a Key Guiding Factor in the Utilization of AI: A Case Study of Samarinda and Aceh

Teachers' digital and pedagogical literacy are among the most important factors in determining how technologies like artificial intelligence (AI) are used in the classroom. According to this study, the pattern of AI use by students was directly impacted by the notable literacy gap between teachers in Samarinda City and Aceh. The majority of Samarinda's teachers have either undergone training or initiated their own learning projects related to integrating AI into the classroom. In addition to having a solid understanding of technology, they can strategically and pedagogically incorporate AI. Teachers present AI as a tool to help students develop their critical and reflective thinking abilities rather than as a replacement for instruction. A Samarinda educator clarified:

"We direct students to use AI as a discussion material, not the final answer. For example, they were told to double-check the results, whether they matched their own books or opinions." (Teacher of Samarinda High School, NVCode_04)

The statement demonstrates how well Samarinda teachers are able to manage student interaction with technology. Teachers with strong pedagogical literacy can position AI as a tool within students' Zone of Proximal Development (ZPD), meaning it is a challenging yet accessible technology with teacher support, as demonstrated by the experience in Samarinda. In this situation, educators actively assist students in learning how to critically evaluate AI output, as well as when and how AI can be applied in a way that is both ethical and beneficial, in addition to introducing the fundamentals of AI. AI thus turns into a tool to support students' higher-level cognitive development. In Aceh, on the other hand, the lack of teacher supervision frequently causes students' use of AI to fall outside their ZPD, either because the technology is too complicated for them to use on their own or because it is only used for basic tasks that they are already capable of. Because there are either no challenges to promote continued growth or, on the other hand, no support to help students realize their full learning potential, learning is suboptimal in both situations.

In Samarinda, they urge students to compare, assess, and challenge the findings rather than accepting information from AI in its unfiltered state. The constructivist learning principle, which holds that students acquire knowledge through contextual, cooperative, and reflective processes, is consistent with this approach. On the other hand, the majority of Acehnese teachers in this study demonstrated difficulties comprehending and using AI technology. Many teachers are unaware of AI's pedagogical potential due to a lack of institutional support and training. They are therefore unable to instruct or mentor students in effectively using these technologies.

This situation results in students using AI as an automation tool without any critical thinking, thereby granting them unrestricted freedom of use. AI turns into a tool that supports the culture of quick and superficial learning when educators are unable to frame the use of technology in terms of specific learning objectives. Another finding from the NVivo thematic analysis was that the interviews with Samarinda teachers consistently included terms such as "teachers' reflection on the use of AI," "integration of AI in learning," and "guidance direction." Meanwhile, "concern,"

"ignorance of the function of AI," and "resignation to use of AI by students" are the more common categories in Aceh. From the results of axial coding, it was found that the level of teachers' digital literacy was directly proportional to the quality of pedagogical supervision of AI use in schools. Teachers with knowledge and skills are better able to create a learning environment that is adaptive to technology. In contrast, teachers with low literacy tend to let students "self-regulate" the often uneducational use of AI.
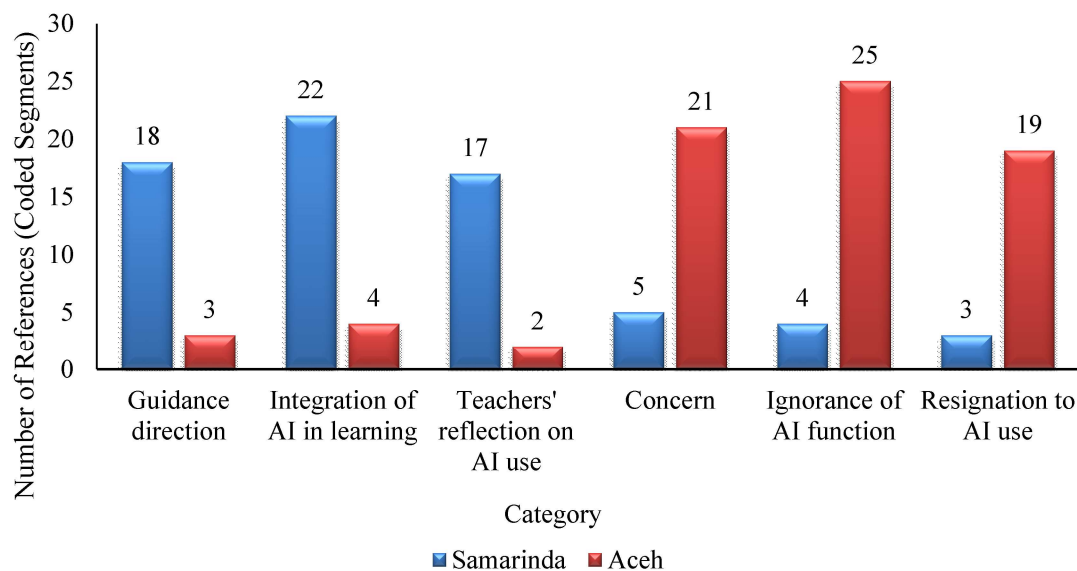

Figure 3. Teacher literacy as a key guiding factor in the utilization of ai: samarinda and aceh
Source: NVIVO14, 2025.

The results of the thematic analysis, conducted using NVivo 14 software, revealed striking differences between teachers in Samarinda and Aceh in their utilization of Artificial Intelligence (AI) technology in the learning process. These differences strongly correlated with the level of digital and pedagogical literacy of teachers in each region. The distribution of categories shows that strategic and reflective categories dominate Samarinda, while passive and negative categories dominate Aceh. The category "Guidance and Direction," for example,

appeared 18 times in teacher interviews in Samarinda, while only three times in teacher interviews in Aceh. This indicates that teachers in Samarinda actively guide students in using AI, helping them understand the technology's functions and use it critically.

This indicates that teachers in Samarinda actively guide students in using AI, helping them understand the technology's functions and use it critically. In contrast, teachers in Aceh tended to provide less clear guidance, resulting in students using AI without adequate pedagogical

supervision. This finding, however, warrants further investigation. Students' reflective use of AI may be influenced by a variety of factors, even though teacher guidance seems to be a crucial one. Samarinda students, for example, might naturally demonstrate higher levels of self-regulated learning, which would allow them to use technology more critically and independently even in the absence of intensive instruction. Furthermore, more regular opportunities for AI tool exploration and experimentation might have been made possible by Samarinda's improved access to reliable internet infrastructure. These alternative theories suggest that, although crucial, teacher support may interact with or even be mediated by more general contextual and learner-specific factors, which warrant further research.

Next, the category "Integration of AI in Learning" reinforced this pattern, appearing 22 times in Samarinda and only four times in Aceh. This indicates that teachers in Samarinda are not only technically familiar with AI but are also able to integrate it pedagogically into their learning strategies. They use AI as a tool to broaden discussions, encourage reflective thinking, and foster deeper understanding in students. Conversely, in Aceh, limited technological knowledge makes it difficult for teachers to incorporate AI into their planned learning strategies. The "Teachers' Reflection on the Use of AI" segment supports the findings of this study. Teacher reflections on the direct impact of AI use were found 17 times in Samarinda, compared to only 2 times in Aceh. This indicates that teachers in Samarinda have metacognitive awareness in their teaching practices and actively correct how AI influences students' behavior and thinking. This contrasts with the categories in Aceh, which are dominated by "Concern," "Ignorance of the Function of AI," and "Resignation to the Use of AI by Students," with occurrences of 21, 25, and 19 times, respectively. The high frequency of these segments indicates that teachers in Aceh tend to experience misunderstanding, confusion,

or helplessness when responding to students' use of AI. This negative tendency is not due to a lack of critical understanding of technology, but rather a lack of adequate training for teachers in Aceh, which allows students to use AI unconsciously and freely without being accompanied by a pedagogical framework, thus fostering a learning culture that tends to be instant and shallow.

This finding is supported by the results of axial coding, which shows a direct relationship between teachers' digital literacy levels and the quality of pedagogical supervision towards AI. Teachers with high literacy, such as those in Samarinda, are able to build learning ecosystems that adapt to technology. Meanwhile, teachers with low literacy tend to leave the use of AI entirely to students, who often lack the critical thinking skills to discern accurate information from AI-generated content. This strengthens the theory of TPACK (Technological Pedagogical Content Knowledge) by Mishra & Koehler (2006), which states that mastery of technology alone is not enough, but must be accompanied by an understanding of pedagogy and appropriate content. Teachers in Samarinda showed better TPACK competence compared to teachers in Aceh, who are still primarily focused on content knowledge without meaningful technology integration. The Urgent Need for Training and Transforming the Role of Teachers, these findings imply an urgent need to conduct systematic and structured training for teachers in various regions, especially in areas with limited access such as Aceh, increase the awareness of educational institutions that AI is not just an administrative assistive technology, but a complex learning instrument that demands in-depth pedagogical understanding, and Encourage a change in the mindset of teachers from the position of The only source of information is to be a learning facilitator who directs the students' thinking process.

In contrast to their Aceh counterparts, who seem to rely primarily on content knowledge (CK) without incorporating technology into their

pedagogy, Samarinda teachers showed a higher degree of TPACK competency. Classroom procedures make this distinction clear. In the case of teachers in Samarinda, they often force their students to critically compare answers or information from textbooks or class discussions with AI, one of which is "ChatGPT". Such an approach demonstrates a genuine integration of pedagogical knowledge (inquiry-based learning techniques), content knowledge (subject matter expertise), and technological knowledge (understanding how AI tools like ChatGPT work). Teachers in some areas of Aceh may lack the technological pedagogical knowledge (TPK) or technology content knowledge (TCK) necessary to create AI-integrated learning activities that foster critical thinking. This is due to a lack of exposure and training. These results suggest that transformative and systematic teacher training is essential in all regions, such as Aceh, where access is limited. However, training should not only cover the basics of using AI tools but also focus on creating AI-based learning activities to foster students' cognitive abilities. For example, trained teachers can design assignments that require students to assess AI responses for bias or limitations, allowing them to draw their own conclusions from these evaluations, rather than simply asking AI to generate instant answers. Students should be able to interact with the material and learning process when given tasks that enhance their metacognitive awareness.

The development of a national AI literacy competency framework for educators, aligned with TPACK and 21st-century learning principles, is urgently needed from both institutional and policy perspectives. Based on this, the government should be able to create policies regarding adaptive digital pedagogical modules as a mandatory part of the learning process or the Continuous Professional Development/Pengembangan Keprofesian (PKB) program. In addition to educating teachers about AI tools, these modules should help them refocus their teaching responsibilities from being the sole source of information to facilitating students' critical engagement with AI-generated content. It can be underlined that the difference in teacher literacy levels between Samarinda and Aceh highlights the uneven access to technology training, which has a direct impact on the quality of education. Local and central governments should strengthen technology-based teacher professional development policies, including providing access to online training, incentives for the adoption of pedagogical technology, and monitoring the use of technology in the school environment (Castillo-Martínez et al., 2023).

The ability of teachers to comprehend the role of technology and relate it pedagogically in learning activities is crucial for the success of integrating AI in the classroom, according to research by Rachbauer et al. (2024) and Ravi et al. (2023). This assertion is supported by your study, which provides empirical evidence that teachers with high AI literacy can utilize AI to aid students in developing their critical thinking skills. In contrast, teachers with low literacy tend to design classroom environments that encourage the ineffective use of AI (Walter, 2024). However, a variety of literary works challenge the notion that AI can only be applied successfully under the guidance of educators. For instance, according to Wang et al. (2025) and Yang et al. (2025), students with high levels of digital literacy can utilize AI independently to develop critical thinking skills without requiring strict guidance from teachers. However, the results of this study offer a more contextual viewpoint, showing that students' independence in using AI reflectively is still heavily reliant on teacher guidance in the reality of secondary education in Indonesia, particularly in regions like Aceh, which have limited access to and training.

Finally, this study makes three significant contributions in the context of novelty. First, a fresh perspective on how social contexts, learning cultures, and educational infrastructure influence

the engagement of teachers and students with AI is offered through the application of a region-based comparative approach. Particularly when considering Indonesian education, this type of research is still uncommon. Second, the NVivo 14 software's thematic analysis approach bridges the gap left by methods that quantitative or survey approaches have dominated by enabling systematic and in-depth exploration of qualitative data. Third, this study uses an integrated analysis framework that clearly connects the three primary components of student use of AI, teacher literacy, and cognitive outcomes.

Thus, this study offers a roadmap for a more contextual, moral, and sustainable digital education policy in addition to illustrating the potential and risks of using AI in education. This study serves as an early warning that the use of AI in the classroom does not always result in higher learning standards. Because AI is not incorporated systemically and pedagogically, it can actually degrade the quality of the learning process in some situations, like Aceh. In this situation, educational establishments ought to create a curriculum centered on Higher-Order Thinking Skills (HOTS) that teaches students how to use AI to formulate problems, organize arguments, and assess data (Habibi et al., 2023); enhancing teachers' abilities through AI pedagogy and technology literacy training so they can mentor students in the ethical and critical use of technology. Additionally, create a learning culture that prioritizes the process over the final product so that students learn to finish assignments and gain a reflective understanding of the subject matter. The study findings on the disparity in AI usage patterns between Aceh and Samarinda have illustrated the potential and dangers of AI in the world of education, both nationally and globally. Any advanced technology can work against students' ability to develop their reasoning and thinking skills if it is not used in conjunction with an adaptive teaching approach and a strong learning culture.

Thus, to sum up, the study's results clearly point to a crucial dichotomy that directly answers the title's central query: "Cognitive Leap or Digital Divide?" Our analysis showed that, depending on the situation, the answer is not either/or but rather both. As demonstrated in Samarinda, AI has the ability to support cognitive leaps in learning when integrated into a pedagogical environment that is bolstered by teacher literacy, critical guidance, and a reflective learning culture. However, in underdeveloped regions like Aceh, where inadequate infrastructure and a lack of teacher expertise result in a superficial, task-oriented use of AI, the same technology can exacerbate the digital and pedagogical divide. This dual reality implies that educational improvement cannot be achieved solely through technological innovation. It must be accompanied by systemic integration into pedagogical frameworks.

■ CONCLUSION

In this study, students' use of AI and teacher guidance when using AI in assignments or in classroom learning have complex and contextual impacts on students' analytical skills. This study shows that artificial intelligence, such as ChatGPT and others, is a technological entity that essentially has a purpose and meaning influenced by regional pedagogical approaches, learning contexts, and digital literacy. AI has shown potential as a contemplative and exploratory stimulant in Samarinda City, indicating that students use AI only as a way to find direct answers and use it as another perspective or reference to strengthen arguments and gain more critical insight. This is because educators in Samarinda City, in this case, teachers, have a highly valued pedagogy and technological literacy to guide the implementation and use of AI more wisely, thereby encouraging metacognition and higher-order thinking skills in their students. On the other hand, in regions like Aceh, AI is often used as a form of automation, with some students using it quickly and passively,

to complete assignments without engaging in further reflection or critical thinking. This is likely due to a lack of teacher literacy regarding digital technology, resulting in AI being underutilized in more effective learning, and thus, students receiving inadequate pedagogical guidance. These results highlight the importance of teacher literacy in determining whether AI can function as a tool that can enhance students' critical thinking skills. Because teachers are expected to provide open, imaginative discussion spaces and offer opportunities for students to critically compare the information obtained from AI, teachers or educators must be able to understand and effectively apply AI to students. If educators lack mastery of the latest technology or often create permissive learning, it is likely to hinder uncritical reliance on technology. Therefore, this study explicitly concludes that teacher competence, local learning culture, and contextual learning strategies interact to significantly influence the success of AI integration in education. In order for AI to be used wisely and beneficially for the transformation of education in Indonesia, efforts must be made clearly through improving digital pedagogical skills for teachers and encouraging the ethical use of AI and the use of pedagogical approaches based on reflection and discussion.

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