Rethinking Critical Thinking Student From AI Assistance to Cognitive Offloading in Elementary School

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Abstract

The development of generative AI (GenAI) makes it easier for students to access information and complete assignments, but it raises concerns that the thinking process is being shifted to technology, especially among elementary school-aged children. Previous studies have primarily focused on the benefits, readiness for adoption, and instructional design, while empirical evidence regarding *cognitive offloading* in Madrasah Ibtidaiyah remains limited. This study aims to identify patterns of GenAI use as a learning aid, examine the shift toward *cognitive offloading*, analyze its implications for students' critical thinking processes, and examine the pedagogical role of teachers. This qualitative field study was conducted at MI Salafiyah Kertoharjo with 10 fourth-grade students and one classroom teacher as participants. Data were collected through observation, student interviews, and teacher interviews, then analyzed using the Miles, Huberman, and Saldaña interactive model, accompanied by source triangulation. The results show that students primarily use GenAI for homework assignments such as poems and questions, usually with help from family members, because the tasks feel difficult, they want to finish quickly, and they are reluctant to read. AI outputs are copied without being processed, so some students cannot explain their work and have difficulty completing similar assignments independently in class. Teachers conduct checks, provide guidance, offer explanations, and offer support, but still find it difficult to distinguish independent work from AI-generated results. The study concludes that GenAI shifts from being a tool to partially replacing the thinking process when not accompanied by cognitive engagement and pedagogical guidance. This study provides triangulated evidence from Islamic elementary education and recommends process-based assignments, verification exercises, strengthening teachers' digital literacy, and parental involvement.

Keywords: generative AI, *cognitive offloading*, critical thinking, Madrasah Ibtidaiyah, teachers' pedagogical role

Introduction

The development of generative artificial intelligence (GenAI) is transforming how students acquire information, compose texts, and complete assignments. This technology offers opportunities as it can serve as a rapid source of learning support. Previous studies indicate that GenAI can support critical, creative, and reflective thinking skills when used appropriately (Essel et al., 2024; Liu et al., 2025; Sardi et al., 2025) . GenAI also provides feedback,

personalized learning, and improved quality of creative solutions (Daniel et al., 2025; Urban et al., 2024) . However, the ease of obtaining AI outputs raises concerns about reduced student engagement in understanding and processing information. This phenomenon has academic implications for students' cognitive development and practical implications for teacher guidance. This issue is particularly important in elementary education because students' reasoning and idea-generation skills are still developing. The use of AI without cognitive engagement is associated with *"cognitive offloading"* in problem-solving (Iqbal et al., 2025) . Therefore, the use of GenAI among Madrasah Ibtidaiyah students needs to be examined to ensure that technology remains a learning aid and does not replace the thinking process.

Cognitive offloading is understood as the transfer of part of an individual's cognitive load to external aids, including technology. Iqbal et al. (2025) indicate that this transfer can serve as a strategy to reduce cognitive load and does not always have negative consequences. Conversely, Roy & Jony (2026) identified instances of superficial cognitive engagement and dependence on AI, while Deng et al.(2025) demonstrated a reduction in mental effort under certain learning conditions. Interest in elementary education is beginning to grow through studies on GenAI adoption readiness (Daeli et al., 2026) and its potential for students' creative thinking (Azzahra et al., 2026) . Qian (2025) emphasizes that the implementation of GenAI requires pedagogical design to ensure learning objectives are met. However, these studies focus more on benefits, readiness, and design than on changes in students' thinking processes. These differing findings indicate that the impact of AI is highly dependent on how students use the technology. The use of GenAI as a means of cognitive offloading among elementary school students has also not been extensively explored empirically. This gap forms the basis for this study of usage patterns, cognitive processes, and the role of teachers.

This study argues that GenAI has the potential to shift from being a learning aid to *cognitive offloading* when students accept AI outputs without understanding, processing, and developing them further. This argument aligns with findings that the impact of AI is determined by students' interaction patterns, not by the mere presence of technology (Iqbal et al., 2025; Roy & Jony, 2026) . The role of teachers in the context of Madrasah Ibtidaiyah is considered crucial for ensuring that AI functions as a learning support(Qian, 2025) . This study focuses on fourth-grade students who are still in the early stages of developing independent thinking. This research has four objectives. First, to identify patterns of GenAI use as a learning aid among Madrasah Ibtidaiyah students. Second, to examine the shift in AI usage from assisting in information retrieval toward *cognitive offloading*. Third, to analyze its implications for students' critical thinking processes. Fourth, to analyze the pedagogical role of teachers in guiding the critical and responsible use of GenAI. Thus, this study provides preliminary empirical evidence regarding the threshold at which AI assistance begins to take over students' thinking processes (Deng et al., 2025)

Methods

Research Design

This study employs a qualitative approach with a field research design. The qualitative approach is used to understand phenomena based on participants' experiences and conditions occurring within the natural context of the research (Xu & Zammit, 2020) . This natural context includes classroom learning activities and assignments completed by students at home. The research design was aimed at obtaining an overview of the use of generative AI in the learning

activities of fourth-grade students at MI Salafiyah Kertoharjo. The research focused on patterns of generative AI use as a learning aid, the shift toward *cognitive offloading*, students' thought processes, and the pedagogical role of teachers in guiding AI use. Qualitative research allows for the collection of data from various sources to gain a deeper understanding of the phenomenon under study (O'Brien et al., 2014) . The use of multiple data sources can also strengthen the credibility of the findings through the process of comparing information across sources (Morgan, 2024) . This approach was chosen because the study emphasizes the meaning of students' and teachers' experiences rather than numerical measurements; thus, the data consists of narrative descriptions that are analyzed gradually and systematically.

Participants

The study was conducted at MI Salafiyah Kertoharjo with fourth-grade students. The research participants consisted of 10 fourth-grade students and one fourth-grade teacher. The 10 students were interviewed to gather information about their experiences using generative AI to complete assignments. Most of the students interviewed reported that they had used AI to help complete homework assignments. The fourth-grade teacher served as an informant to gather information regarding students' use of AI and their condition during learning activities. Participant selection was based on their direct involvement in the phenomenon under study. The use of students and teachers as sources of information in qualitative educational research is also applied in field studies that employ interviews and observation (Hidayat & Yusuf, 2023) . The limited number of participants allows the researcher to explore each student's experience in greater detail. Students were selected because they directly experienced the use of AI, while teachers observed the students' conditions during learning. With this composition, data were obtained from those who used AI and those who observed its impact.

Research Procedures

The study began with observations of students during learning activities in the fourth-grade classroom. Observations were used to record students' activities while working on assignments and the conditions observed during the learning process. Observations were also made of students' work related to homework and assignments completed at school. The researchers then conducted interviews with 10 students to gather information about their experiences using generative AI and their experiences while completing assignments. Subsequent interviews were conducted with fourth-grade teachers to gather information on students' use of AI and the teachers' responses to these situations. The combined use of interviews and observations provides a more comprehensive picture of the phenomena occurring within the learning context (Sukendar et al., 2019) . Observations were conducted in fourth-grade classrooms so that task-completion conditions could be observed directly. This sequence allowed the researcher to compare the observed conditions with students' accounts and teachers' explanations. Data from these three sources were then examined and categorized according to the research focus.

Data Collection Techniques

Research data were collected through observation and interviews. Observations were conducted on students during the fourth-grade learning process and on the results of their work related to both homework and in-school assignments. Interviews were conducted with 10 students and one fourth-grade teacher. Student interviews focused on their experiences using generative AI, the types of assignments they received assistance with, and their experiences while completing assignments directly in class. The teacher interview focused on students' use

of AI, students' performance in completing assignments, and the teacher's actions in guiding the use of this technology. Semi-structured interviews can be used to obtain in-depth information about participants' experiences in qualitative research (O'Connor & Joffe, 2020) . Observation and interviews can also be used simultaneously to obtain data from observed activities and direct explanations from participants (Sutanto & Murdiono, 2025) . All three data sources are recorded according to the research focus so they can be easily grouped and compared during the analysis phase. The use of multiple data collection techniques allows researchers to compare information to enhance the accuracy of data interpretation.

Data Analysis Technique

Data were analyzed using the Miles, Huberman, and Saldaña interactive model, which includes data condensation, data presentation, and verification. This model was used to process the data in stages, from the time the data were collected until the research conclusions were drawn. During the condensation stage, the researcher selected, focused, simplified, and grouped the data based on the four research focuses: patterns of generative AI use, the shift toward *cognitive offloading*, students' thought processes, and the pedagogical role of teachers. During the presentation stage, the data were organized into narrative descriptions based on the research focuses so that patterns and relationships among the data would appear more systematic (Raskind et al., 2019) . During the verification stage, the researcher identified emerging patterns and compared information from student interviews, observations, and teacher interviews. This model has also been applied in Indonesian educational research utilizing interviews and observations (Kustyandari & Sulistyani, 2025) . A review of the field data was conducted to ensure that the conclusions aligned with the actual conditions in the fourth-grade classroom. This procedure ensures the consistency of the qualitative analysis process from data collection to the formulation of final conclusions (Sutanto & Murdiono, 2025) .

Results

Patterns of Generative AI Use as a Learning Aid

Interviews with 10 fourth-grade students revealed that most had used GenAI to help complete homework assignments. The applications mentioned included Gemini AI to help compose poems for assignments, as well as ChatGPT and Dola to answer questions. Students used these tools when assignments felt difficult and they wanted to finish quickly, with access generally facilitated by their families. This use occurred while they were working on learning assignments at home. Observations found that the tasks assisted with included free-theme poems collected at the next class meeting and fill-in-the-blank and essay questions completed outside of class hours. Some answers used sentence structures different from those in the student workbook. The fourth-grade teacher confirmed that some students used GenAI for homework assignments, particularly for poems and questions. The teachers' statements align with student interviews and observations. These three data sources indicate that students primarily use GenAI to complete homework assignments. This data is limited to the form, type of assignment, timing, and context of GenAI use as a source of assistance.

The Shift Toward *Cognitive Offloading*

Interviews with students revealed that the use of GenAI extends beyond simply searching for information. Students admitted to directly copying AI search results—after their parents or family members helped them find the answers—without modifying or rephrasing them. For a poetry assignment, students admitted that their work was produced with the help of Gemini AI.

The same pattern was observed in assignments requiring students to answer questions. Observations revealed that the homework poem contained vocabulary that fourth-grade students had not yet mastered and a greater number of lines than the poems students wrote in class. When a similar assignment was given in class without outside assistance, most students asked the teacher for examples, some remained silent, and only a small fraction attempted to compose a poem on their own. Teachers expressed concern that students were delegating their thinking skills to AI and merely writing down the results. Teachers also found that many students struggled with essay questions in class. This data serves as field evidence of a shift in the nature of assistance—from information retrieval to the use of ready-made technological outputs—as well as the differences between homework assignments and the work processes observed directly in class.

Implications for Students' Critical Thinking Processes

Interviews revealed that some students who used GenAI were unable to paraphrase the content of the poems they had collected. They also struggled to answer questions similar to those in previous assignments when these were revisited during class. Students admitted that they sometimes found it difficult to find answers in textbooks, even though a review of the material showed that the information was available in other sections. A reluctance to read was cited as the reason for not independently seeking information in the textbook. Observations noted that during the in-class poetry-writing activity, most students asked the teacher for examples, some remained silent, and a small number attempted to formulate their own ideas. When completing assignments without technology, students still made an effort to find answers on their own, although some still required teacher guidance. For essay questions, students struggled to find answers in the course material, so the teacher provided additional explanations and guidance. Interviews with teachers confirmed that many students had difficulty finding answers to essay questions in class. These data illustrate students' challenges in understanding information, finding answers, and explaining their work, as well as the need for them to read, locate information, and formulate answers independently.

Teachers' Pedagogical Role in Guiding Critical and Responsible AI Use

The fourth-grade teacher was aware of some students' habit of using AI for homework assignments and confirmed this by asking the fourth-grade students directly. The teacher explained the proper use of AI and asked students to complete their assignments using their own creativity. Students are allowed to consult their textbooks but are not permitted to look up answers using cell phones or AI. Teachers provide additional explanations and guidance when students struggle, and review assignments that differ from the level of ability demonstrated in class. Teachers expressed concern that the continuous use of AI eliminates opportunities for independent thinking. They also noted a tendency for students to complete assignments with the help of AI, which needs to be addressed in the learning process. One challenge mentioned is the difficulty in distinguishing independent work from AI-generated results. The teacher also emphasized the need to boost students' confidence in answers derived from their own thinking. The teacher does not direct students to rely on AI as a source of answers to be trusted, but rather on their textbooks and their own abilities. The teacher's actions include checking work, providing guidance, offering clarifications, and offering support in addressing students' use of AI in fourth grade.

Discussion

The use of GenAI by fourth-grade students occurs primarily in homework assignments, driven by the difficulty of the tasks, a desire to finish quickly, and a reluctance to read textbooks. These efficiency-driven reasons align with the findings of Asisah et al. (2025), who discovered that students use ChatGPT primarily to complete tasks more quickly. Koten et al. (2026) note that the ease of accessing information is accompanied by concerns about dependency. Nurcahyani and Noviani (2026) found that ChatGPT's answers are often accepted without verification, as students copy the AI's output. The habit of accepting instant answers risks reducing mental effort (Deng et al., 2025) . Jose et al. (2025) refer to this condition as the paradox between the enhancement and erosion of abilities. Access to Gemini AI, ChatGPT, and Dola—facilitated by family members outside of direct teacher supervision—reinforces this pattern. Consequently, GenAI is used as a provider of ready-made answers rather than as an aid for understanding and processing material. This indicates a focus on outcomes rather than the learning process. These findings address the first objective regarding usage patterns.

A shift toward *cognitive offloading* occurs when students copy AI outputs without modifying them and make them the main part of their assignments. Zhu et al. (2026) distinguish between dependent offloading—delegating core thinking to AI—and autonomous offloading, which retains cognitive control. This finding aligns more closely with the first form because students do not process the AI's output. Lin and Al-Hada (2026) add that routine offloading with weak monitoring differs from intentional episodic offloading. Fan et al. (2025) refers to the tendency to delegate metacognitive responsibility to AI as "metacognitive laziness". Gerlich (2025) reports that AI use is associated with a decline in critical thinking through cognitive disengagement. Iqbal et al. (2025) point out that offloading is not always detrimental; rather, the issue lies in the loss of students' role as active and critical information processors. The benefits of GenAI in other studies depend on structured learning designs, which were not present in the context of this research (Zhao et al., 2025). These findings address the second objective regarding the shift toward *cognitive offloading*.

This shift implies a weakening of critical thinking processes when students work without AI assistance. Students who collected poems at home were unable to paraphrase their content and struggled to answer the same questions in class. Li et al. (2026) demonstrate that AI-dependent offloading is associated with a weakened sense of ownership over one's work. Firdaus et al. (2025) concluded that overreliance on AI weakens cognitive abilities, critical thinking, and creativity. Zhou et al. (2024) found that self-regulation mediates the relationship between GenAI use and critical thinking, and a reluctance to read indicates weak self-regulation. Sardi et al. (2025) emphasize that the benefits of GenAI depend on guided self-directed learning. Studies involving guided learning report improvements in critical thinking (Nuwa et al., 2025). The difference lies in the context, as students use AI at home without structured assignments. Consequently, homework no longer reflects students' thinking abilities because the learning product and process have become disconnected. These findings address the third objective.

The teacher's pedagogical role determines whether GenAI functions as an aid or becomes a hindrance to learning. Teachers are familiar with students' habits; they verify this by asking direct questions and then guide students to use textbooks without looking up answers on their phones. Teachers also provide explanations and instructions, but it remains difficult to distinguish independent work from AI-generated results. The benefits of AI become apparent

when the technology helps students tackle difficult tasks (Daniel et al., 2025; Iqbal et al., 2025) . Its drawbacks emerge when students copy answers, are reluctant to read, and lose opportunities for independent thinking (Jose et al., 2025). Roy and Jony (2026) report superficial engagement among GenAI users, which aligns with teachers' concerns. Qian (2025) emphasizes that GenAI requires pedagogical design to ensure learning objectives are maintained and that the technology supports students' thinking processes. Sardi et al. (2025) direct the use of AI toward independent learning, rather than merely task completion. Therefore, a ban alone is insufficient, and teacher guidance must focus on students' thinking processes, not just on task outcomes. These findings address the fourth objective.

These findings call for an action plan that positions teachers, madrasahs, and parents as guides in the use of GenAI. First, teachers need to design assignments that assess the process, such as asking students to paraphrase a poem or their answers in class. Second, the initial development of ideas should be done without AI, in line with the need for pedagogical design that emphasizes (Qian, 2025) . Third, verification exercises should be provided because students often accept ChatGPT's answers without checking them (Nurcahyani & Noviani, 2026). Fourth, madrasahs need to organize professional development for teachers because Azzahra et al. (2026) identify teachers' digital literacy as a major challenge. Fifth, parents need to be involved so that assistance at home does not take over the process of students formulating their own answers. Zhou et al. (2024) highlight the importance of self-regulation, so the habit of reflecting on one's work needs to be practiced regularly in class with the teacher. Zhao et al. (2025) recommend medium- to long-term interventions to sustainably strengthen critical thinking in madrasahs. With these measures, AI remains a learning tool and does not replace students' thinking processes.

Conclusion

This study concludes four key points in line with its research objectives. First, fourth-grade students at MI Salafiyah Kertoharjo primarily use GenAI for homework assignments such as poems and questions, with access facilitated by their families. This conclusion was derived from a comparison of observational data, student interviews, and teacher interviews. The reasons for its use include the perceived difficulty of assignments, a desire to complete tasks more quickly, and a reluctance to read. Second, this assistance shifts into *"cognitive offloading"* when AI outputs are copied without modification and become the main component of the assignment. Third, this shift weakens critical thinking processes, evident in students' difficulty rephrasing their work and completing similar assignments independently in class. Fourth, teachers play a role through checking, guiding, re-explaining, and providing support; however, it remains difficult for them to distinguish independent work from AI-generated output. Thus, the research argument is supported that GenAI has the potential to shift from a tool to a partial substitute for students' thinking processes when not accompanied by cognitive engagement and pedagogical guidance. This shift is particularly evident in homework assignments that no longer reflect students' abilities.

Theoretically, these findings reinforce that the impact of AI depends on patterns of student interaction—not merely the presence of technology—and thus students' cognitive engagement must be maintained through teacher guidance. The novelty of this study lies in the triangulation of observations, student interviews, and teacher interviews at an elementary madrasah. These findings also complement previous studies, which have largely focused on the

benefits of GenAI for college students and have not yet highlighted elementary madrasah students. Practically, madrasahs need to design process-based assignments, train students in verification and reflection, develop teachers' digital literacy, and involve parents. Such guidance ensures that AI remains a learning aid. A limitation of this study is that it involved only one class and one teacher, so the findings cannot be generalized. Additionally, the assessment of how well the assignment results align with the students' age-appropriate remains based on the researcher's and teacher's evaluations. Future research should involve more schools and grade levels. Subsequent studies could also test medium-term guidance interventions—such as process-based assignments and verification training—on students' critical thinking skills

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Conflict of interests

The author declares that there are no conflicts of interest.

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