

# Analyzing Student Cognitive Engagement in AI-Based Learning Using Prompting Techniques

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## Article Info

### Article history:

Received Mar 12th, 2025

Revised Apr 18th, 2025

Accepted May 24th, 2025

### Keyword:

AI-Based Learning

Analyzing Student

Cognitive Engagement

Prompting Technique

## ABSTRACT

With the increasing integration of AI in education, understanding how students engage cognitively in AI-assisted learning is crucial. Cognitive engagement in AI-assisted learning is important because it helps students interact meaningfully with AI tools, process information critically, and enhance their learning outcomes through effective AI-driven feedback and responses. To improve response quality in AI, one effective method is utilizing prompting techniques, which guide AI to generate more accurate, relevant, and structured responses, enhancing student learning experiences. This research investigates students' cognitive engagement when learning with AI-based tools using different prompting techniques, including Zero-Shot, Chain of Thought, Interactive Prompting, and Elaborate Prompting. A total of 54 students participated, and their engagement was assessed using a cognitive engagement questionnaire. The results, analyzed through a One-Sample T-test, reveal that students demonstrate significantly positive in cognitive engagement when using prompting techniques in AI-based learning. Furthermore, the findings suggest that effective prompting enhances the quality of AI-generated responses, positioning AI Chatbots as valuable learning assistants. This study provides important insights into optimizing AI-based learning strategies, highlighting the role of prompting in fostering deeper student interaction and engagement with AI tools.

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DOI: <http://dx.doi.org/10.24014/ijaidm.v8i2.36160>

## 1. INTRODUCTION

The development of Artificial Intelligence (AI) technology in education has undergone rapid and extensive evolution, creating numerous opportunities for its application in the learning process [1]. AI technology, in simple terms, is a technological advancement that can simulate human intelligence using machine technology through data collection, machine learning algorithms, and other methods. Essentially, AI technology has been in use for a long time, but it experienced rapid growth in early 2020, when the world began to highlight its potential in the field of education [2]. Currently, the development of AI in education is entering the realm of chatbot technology. There are many types of chatbots available today, such as ChatGPT, Gemini, Bard, and others. Chatbots can provide users with information-based responses tailored to the input they receive [3]. In the field of education, chatbots are utilized by educators and learners to quickly access academic information [4].

The use of chatbots has attracted the attention of academics due to their ability to provide information quickly and facilitate personalized conversations between users and the chatbot. Building personalization between machines and users can have a positive impact on user interaction and engagement

with chatbots [5]. Personalization is a key aspect of interacting with chatbots, as it allows users to engage in more natural conversations with AI. As a result, several previous studies have attempted to develop chatbots with user profile personalization [6]. In the field of education and academia, personalization is beneficial for tailoring chatbot interactions to users' information seeking needs. Therefore, previous studies have focused on enhancing chatbot personalization to improve users' learning experiences [7], [8]. Prompts are external cues or signals intended to guide individuals toward a desired action or response, so that when the stimulus naturally occurs, no additional prompts are needed. In education, the use of prompt techniques has a positive impact on learning, helping students allocate more study time and enabling them to independently manage their learning activities [9]. Currently, prompting techniques are being integrated into various AI technologies, including chatbots like ChatGPT. ChatGPT responds to user input in the form of text, providing information that can be either detailed or simple, depending on the user's input [10]. Prompting techniques are applied in chatbot technology, such as ChatGPT, to guide responses in alignment with the intended objectives.

Previous research has shown that well designed prompting techniques have a positive impact on eliciting desired responses or behavioral changes in students [11], [12]. Therefore, designing effective prompting techniques to foster positive changes in students remains an important area for future research. Challenges related to improving students' academic skills such as critical thinking, learning engagement, and personalized learning continue to be explored in education, particularly through the integration of advancing technologies [13], [14]. Chatbots like ChatGPT serve as a solution for enhancing these areas by implementing well designed prompting techniques that generate the desired stimuli and responses. Personalized learning becomes more accessible with ChatGPT, as the technology can adapt to users' learning pace and style, providing tailored educational information to meet their needs [15]. Prompting techniques have significant potential to generate essential stimuli in learning, encouraging desired student responses that lead to positive outcomes. Enhancing the responsiveness of AI-powered chatbots in a more effective and structured manner can further increase student engagement, particularly in their interactions during the learning process [16]. Determining the appropriate prompting techniques is a challenge for researchers in the field of AI chatbots, as it requires designing prompts that effectively generate positive stimuli to enhance specific areas of student learning. Developing these techniques requires a deep understanding and careful design. Research on the application of prompting techniques in AI has demonstrated that students develop different prompting strategies that lead to different response qualities and learning [17]. The study examined how students employ various prompting techniques in learning which are single copy-and-paste prompting, single reformulated prompting, and multiple-question prompting. In this research, students will be introduced to several widely used prompting techniques in AI, such as Zero-Shot, Chain of Thought, Interactive, and Elaborate prompts and these techniques will be applied to specific learning topics, with the selection of the most suitable technique tailored to the needs or requirements of each topic for optimal effectiveness.

Cognitive Engagement (CE) refers to a state in which students are motivated and willingly complete assigned tasks with full awareness and deliberate effort. The design of prompting techniques in education plays a crucial role in generating specific stimuli that positively impact students during the learning process with ChatGPT, particularly in enhancing cognitive engagement. Therefore, researching the use of prompting techniques in education is essential to examine their impact and assess the effectiveness of their application in fostering students' cognitive engagement when learning with technologies like ChatGPT. Previous studies have proposed integrating the theory of Self-Regulated Learning (SRL) with cognitive engagement [18], where this integration aims to explain how the phases and subprocesses of SRL and cognitive engagement are interconnected. In the context of using AI for student learning, SRL plays a crucial role in the information seeking process. Students independently search for knowledge, linking the information they obtain to the problems they are addressing. Additionally, previous studies have found that the use of appropriate and consistent learning strategies enhances students' cognitive engagement when using educational technology, as it encourages active participation with the technology [19]. As a result, emerging technologies capture students' attention, increasing their investment in learning activities that involve technological tools. Therefore, integrating technology with effective and consistent learning strategies can foster positive learning outcomes. In the context of AI, rapid information retrieval enhances students' learning efficiency and task completion, making it a key priority in AI-based education. This leads to the assumption that cognitive engagement emerges when students actively seek information through technologies like ChatGPT and connect learning problems with AI-generated responses. Consequently, there is an urgent need to understand the use of prompting techniques when students learn with ChatGPT, given its various effective benefit.

## 2. RESEARCH METHOD

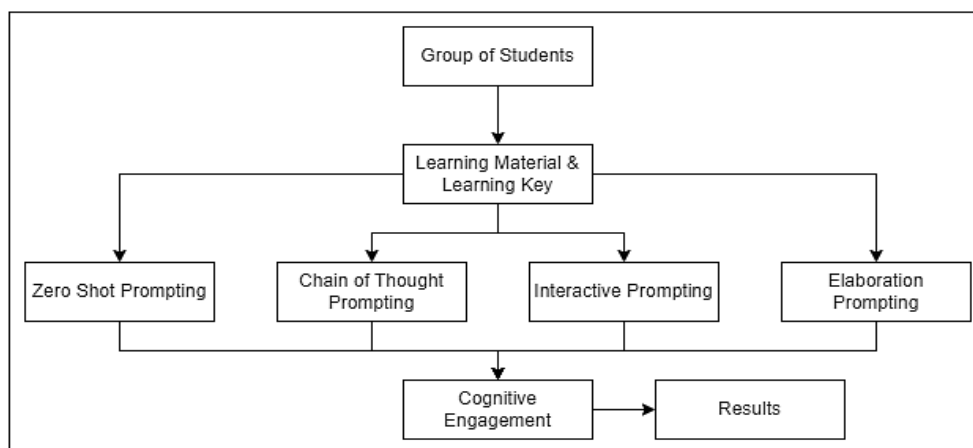
This study is a quantitative research that provides data on students' understanding of various types of prompts and their level of cognitive engagement while using them. Data collection is conducted through

questionnaires designed to measure students' cognitive engagement levels. The questionnaire used, presented in Table 1, assesses cognitive engagement by adapting indicators from previous research, with modifications made to align with the context of prompt usage [20]. Cognitive engagement indicators reflect how actively and effectively students interact with AI-based learning materials. These indicators assess students' ability to manage their own learning, the depth of their engagement with content, and their level of active involvement. They also highlight students' dedication and motivation to learn, evaluate the clarity and relevance of their responses, and measure how well they apply various prompting techniques in their learning process. This questionnaire employs a Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

**Table 1.** Cognitive Engagement Indicators

Indicator		Sub-Indicator
Self-Regulation	Q1	Monitoring Progress
	Q2	Persistence
Depth of Processing	Q3	Critical Thinking
	Q4	Reflection
Interaction with Content	Q5	Problem Solving
	Q6	Active Inquiry
Effort and Motivation	Q7	Curiosity
	Q8	Effortful Learning
Response Quality	Q9	Cognitive Load Management
	Q10	Depth of Response
Engagement with Prompts	Q11	Questioning & Reasoning
	Q12	Adaptation to Feedback
	Q13	Improvement Over Time
	Q14	Reflection
	Q15	Strategy Uses

The study was conducted in a school setting at SMK Negeri 10 Malang, within a classroom environment, involving a total of 54 students. The research variable focuses on cognitive engagement in the application of various types of prompting used by students through ChatGPT. The research design is illustrated in Figure 1, and the study was carried out with a group of students selected through purposive sampling. The implementation technique involved providing modules and questionnaires containing guidelines on using four types of prompts: 1) Zero-shot Prompting, 2) Chain of Thought Prompting, 3) Interactive Prompting, and 4) Elaboration Prompting. After the study, students were asked to complete a questionnaire to measure their level of cognitive engagement.



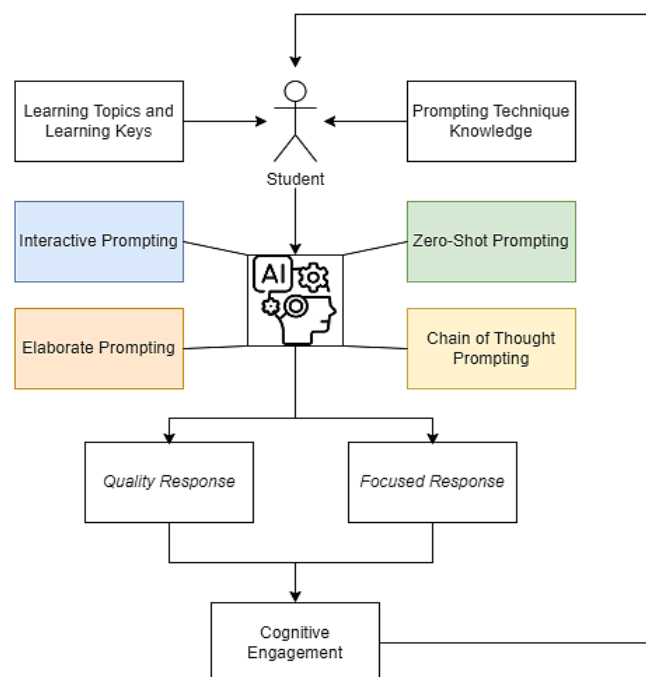
**Figure 1.** Research Design

Zero-Shot Prompting (ZSP) generates responses without requiring specific instructions or examples and is typically used to assess fundamental knowledge without prior guidance. Chain of Thought (CoT) prompting encourages the Chatbot to explain its responses step by step, making it ideal for answers requiring detailed explanations, such as solving multi-step calculations. Interactive Prompting (IP) allows dynamic interaction between the Chatbot and users, facilitating back-and-forth exchanges of information. Meanwhile, Elaboration Prompting (EP) provides responses by expanding or offering more detailed information on a specific answer or topic. Examples of these prompting techniques can be found in Table 2.

**Table 2. Cognitive Engagement Indicators**

No.	Prompting Types	Example Input
1.	Zero-Shot Prompting	"Give me a brief explanation of this." "Explain how it works briefly." "Describe the general idea of this topic." "Define the concept with a comprehensive explanation."
2.	Chain of Thought Prompting	"Compare this topic with something related to it." "Solve this step by step." "Explain your reasoning in detail." "Break down this problem into logical steps." "Think through each part carefully and explain your thought process." "Explain this section with a detailed step-by-step solution."
3.	Interactive Prompting	"What are your thoughts on [sub-topic]?" "How would you respond to [sub-topic]?" "Can you elaborate on [sub-topic]?" "What if [Sub-topic 1] is related to [Sub-topic 2]?" "What is your opinion on [sub-topic]?"
4.	Elaborate prompting	"Explain more about [Topic]." "Expand on the discussion about [Topic]." "Tell me more about [Topic]." "Provide additional information about [Sub-topic]." "Discuss [Sub-topic] in more detail."

The research flow as illustrated in Figure 2 outlines the learning process where students receive key learning topics and concepts before using the AI Chatbot technology, then interact with ChatGPT specifically with the given prompting techniques to obtain Quality Responses and Focused Responses that are aligned with their learning. This structured interaction with ChatGPT fosters deeper understanding and clear information, which in turn enhances cognitive engagement by encouraging students to actively process and reflect on the information received.

**Figure 2. Research Flow**

The learning content provided to students includes a brief overview of the learning topic, key learning concepts, ChatGPT, and a notepad. The learning topic introduces students to the subject they will explore, while the key learning concepts serve as essential points that students must understand when using ChatGPT for further exploration. The notepad is used to record key points that can be reviewed and discussed later. A summary of the learning content and materials provided can be found in Table 3.

**Table 3.** Learning Materials and Key Learning

Subject	Topic	Learning Keys	Prompting Types
Mathematic	Pythagorean Theory	<ol style="list-style-type: none"> <li>1. Understand the Pythagorean Theorem.</li> <li>2. Be able to explain the Pythagorean Theorem formula.</li> <li>3. Be able to comprehend and solve example problems using the Pythagorean Theorem.</li> <li>4. Understand how the Pythagorean Theorem is applied in real life situations.</li> </ol>	Chain of Thought Prompting
Physics	Gravitation	<ol style="list-style-type: none"> <li>1. Understand what Gravity is.</li> <li>2. Be able to explain how Gravity works.</li> <li>3. Understand the Universal Law of Gravitation.</li> <li>4. Understand how Gravity affects humans.</li> </ol>	Zero-Shot Prompting
Biology	Animal Food Type Groups (Carnivores, Herbivores, Omnivores)	<ol style="list-style-type: none"> <li>1. Understand how carnivores, herbivores, and omnivores find food.</li> <li>2. Be able to differentiate carnivores, herbivores, and omnivores based on their appearance.</li> <li>3. Be able to identify how animals are categorized as omnivores.</li> <li>4. Be able to explain more about the behavior of carnivores, herbivores, and omnivores.</li> </ol>	Interactive Prompting
History	Indonesian Independence day	<ol style="list-style-type: none"> <li>1. Understand why Independence Day is important.</li> <li>2. Understand the centuries of colonization in Indonesia.</li> <li>3. Be able to explain why honoring national heroes is important.</li> <li>4. Understand the types of colonization and oppression in Indonesia.</li> </ol>	Elaboration Prompting

Research on the use of prompting techniques in ChatGPT and their impact on student learning remains limited. Therefore, this study's hypothesis on cognitive engagement variables uses an optimal or neutral average as the basis for decision-making. The proposed research hypotheses are as follows: (1) Null Hypothesis (H<sub>0</sub>): Sig. = 3, indicating a neutral level of cognitive engagement, and (2) Alternative Hypothesis (H<sub>a</sub>): Sig. > 3, indicating a positive level of cognitive engagement. The decision making process to determine cognitive engagement levels in this study will be analyzed using a One-Sample T-test. Additionally, descriptive statistical analysis will be used to identify cognitive engagement indicators with the highest and lowest values.

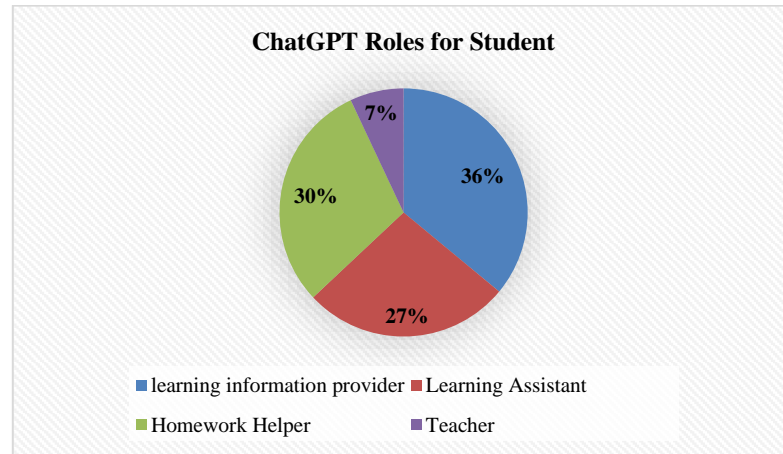
### 3. RESULTS AND ANALYSIS

This study began by exploring the research subjects' knowledge of ChatGPT technology and its role for students. The research subjects were students at SMK Negeri 10 in Malang City. Among the 54 students who completed the pre-research questionnaire, 92% reported being aware of ChatGPT technology, and 72.2% stated that ChatGPT helped them by providing general knowledge and independent learning related information. Additionally, 68.5% of students mentioned that they would use ChatGPT if they encountered difficulties in learning. Furthermore, as shown in Figure 3, the identified roles of ChatGPT include Learning Assistant (27%), Learning Information Provider (36%), and Homework Helper (30%). These findings align with previous research on the role of ChatGPT for students, demonstrating that this technology enhances independent and adaptive learning (Fauzi et al., 2023).

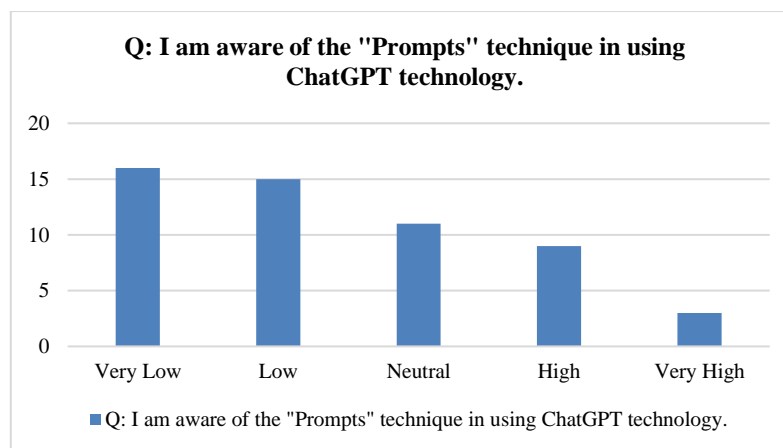
Based on Figure 4, knowledge of prompting techniques in ChatGPT remains limited among students, with a total of 77.8% falling into the low and neutral categories, despite the high usage of ChatGPT and its recognition as a learning assistant for students. The appropriate use of prompting techniques in ChatGPT has been proven to enhance the quality of responses to the information provided [21]. The measurement of cognitive engagement in the use of prompting techniques was conducted through a questionnaire adapted from previous research, with adjustments made to fit the context of prompting techniques in ChatGPT. The research method employed was an experiment study involving 54 students from an educational institution. The results indicated an improvement in students' understanding of prompting techniques in ChatGPT after the study, leading to a more consistent comprehension of prompting techniques among students.

Data collection was conducted through the distribution of questionnaires accompanied by a module containing knowledge about prompting techniques in ChatGPT. After data collection, descriptive statistical analysis was applied. Given that the topic of prompting techniques for students remains limited, the research hypothesis was based on a neutral cognitive engagement condition, represented by a score of 3. The results showed that the maximum mean score achieved was 4.40, while the minimum mean score was 2.53. Since

the mean scores were above the neutral hypothesis score, this indicates that the use of prompting techniques in ChatGPT positively impacts students' cognitive engagement. Furthermore, normality testing was conducted using the Shapiro-Wilk test, yielding a Sig. value of  $0.20 > 0.05$ , indicating that the data were normally distributed. Additionally, the measurement results of students' cognitive engagement based on the applied indicators are presented in Table 4.



**Figure 3.** ChatGPT Roles for Student



**Figure 4.** Prompting Technique Knowledge from Student

**Table 4.** Students Cognitive Engagement Result

No.	Sub-Indicator	Means	Std. Deviation	Total
Q1	Monitoring Progress "I monitor my progress and adjust my learning prompts as needed."	4.01	0.65	217
Q2	Persistence "I persist through challenging prompts or tasks without giving up."	3.70	0.69	200
Q3	Critical Thinking "I engage in critical thinking by analyzing and evaluating the information provided by ChatGPT."	2.50	0.63	135
Q4	Reflection "I reflect on my reasoning and explain my thought process when responding to prompts."	3.85	0.78	208
Q5	Problem Solving "I effectively use prompts to break down complex problems and find solutions."	3.40	0.78	184
Q6	Active Inquiry "I actively explore different perspectives and seek a deeper understanding through the prompts."	3.61	0.71	195
Q7	Curiosity "I display curiosity by pursuing additional exploration of topics initiated by prompts."	3.66	0.86	198
Q8	Effortful Engagement "I put effort into engaging with more challenging prompts rather than"	2.67	0.71	137

No.	Sub-Indicator	Means	Std. Deviation	Total
Q9	choosing easier ones.” Cognitive Load Management “I manage the difficulty of tasks, taking on prompts that are appropriately challenging for me.”	3.38	0.87	183
Q10	Depth of Responses “I provide detailed, thoughtful, and evidence based responses rather than brief or surface level answers.”	3.72	0.81	201
Q11	Questioning and Reasoning “I demonstrate reasoning and critical thinking by questioning the assumptions in prompts or exploring alternative viewpoints.”	2.90	0.75	157
Q12	Adaptation to Feedback “I actively incorporate feedback from ChatGPT or prompts into my responses.”	3.62	0.75	196
Q13	Improvement Over Time “I show improvement over time by adapting to more complex or nuanced prompts.”	2.87	0.70	155
Q14	Reflection “I reflect on my thinking process, understanding how I arrived at my answers or conclusions.”	3.75	0.75	203
Q15	Strategy Uses “I identify and use strategies to improve my understanding or solve problems more effectively.”	3.53	0.71	191

The One-Sample T-test was conducted to determine whether the mean of a single sample significantly differs from a known or hypothesized population mean. This test was performed using SPSS Version 25. Based on Table 5, the results showed a Sig. 2-tailed value of  $0.00 < 0.05$  and a t-value of 7.91, indicating that the cognitive engagement scores of students using prompting techniques were significantly greater than 3, placing them in the positive category.

**Table 5.** One Sample T-test

t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval	
				Lower	Upper
7.91	53	0.00	0.51	0.37	0.64

### 3.1 Students' Understanding of Prompting Techniques

ChatGPT technology is an AI system that provides text-based responses, offering information or feedback based on user input. Therefore, generating responses that align with the intended purpose can enhance the quality of ChatGPT's answers. Additionally, effective prompting techniques can improve ChatGPT's performance, including the accuracy and contextual relevance of its responses [22]. Therefore, the use of prompting techniques can assist students in searching for information related to learning. The primary role of ChatGPT is as a learning assistant and information provider, as the speed and clarity of the information it delivers are considered beneficial for students. The ability to quickly and accurately provide general information makes ChatGPT technology valuable in education and for students seeking learning materials. This aligns with Walker's findings, which showed that in the medical field, the use of ChatGPT technology for obtaining medical information for patients has proven to be fast and reliable [23]. The prompting technique in ChatGPT requires careful design to ensure that the provided stimulus and expectations align with the intended objectives [24]. Providing guidance in the form of text-based prompting is useful for generating a stimulus in specific situations, such as applying prompting techniques in education or academic contexts. The need for prompting in education is based on an educator's goal to stimulate learners by fostering motivation, curiosity, and critical thinking about a particular subject.

This study involved subjects ( $n=54$ ) who were students, aligning with the research objectives. The majority of students (mean = 2.27) reported having limited or minimal knowledge of prompting techniques when using ChatGPT. The learning process begins by grouping students based on the available learning materials and prompting techniques. After receiving the learning module, students utilize ChatGPT as an AI-based learning tool with guided prompting techniques. For example, in a mathematics lesson on the Pythagorean theorem, students use chain-of-thought prompting to break down problem-solving steps. They might start by asking ChatGPT, "How do I find the hypotenuse of a right triangle?" and then refine their understanding by prompting further, "Can you show a step-by-step example with a triangle where the legs are 3 and 4?" Through this process, students develop logical reasoning by engaging in structured, multi-step problem solving. Once they have explored the content and achieved the key learning objectives, an evaluation is conducted to assess their cognitive engagement after learning. After the learning phase, there

was an increase in their understanding of how to use prompting techniques (mean = 3.98). This allowed researchers to measure students' cognitive engagement with a consistent level of initial knowledge to draw conclusions. The types of prompting techniques used in this study were Zero-shot Prompting, Chain of Thought Prompting, Interactive Prompting, and Elaborate Prompting. Each type of prompting has distinct characteristics based on the nature of the input and the expected output. For example, Chain of Thought Prompting encourages ChatGPT to provide responses by outlining the reasoning process step by step until a conclusion is reached [25].

During the study, observations revealed that prompting techniques were effectively applied when students engaged with key learning topics. In Chain-of-Thought Prompting, students explored ChatGPT's responses by breaking down problems step by step, such as solving mathematical equations progressively. An example prompt used, as shown in Figures 5 and 6, was: "If a right triangle has a hypotenuse of 13 cm and one of its other sides is 5 cm, how do you calculate the length of the unknown side? Explain with logical steps." This prompt led ChatGPT to generate a detailed solution with step-by-step explanations. Additionally, Zero-Shot Prompting allowed students to receive immediate responses from ChatGPT without prior examples or context. For instance, a prompt like "What is the pythagorean theorem?" enabled ChatGPT to generate a direct and informative answer, providing foundational knowledge within the learning context. These prompting techniques aligned responses with students' expectations or learning objectives when applied in an appropriate context.

### 3.2 Cognitive Engagements Results in Students

Cognitive Engagement refers to students' willingness to exert effort in learning, accompanied by awareness in using cognitive and metacognitive strategies, as well as a desire to understand the material being studied [26]. In understanding the concept of Cognitive Engagement, it is emphasized that educators play a crucial role in fostering students' investment in learning, including their level of motivation and the learning strategies implemented by the educator [27]. Learning technology is no longer limited to the role of teachers alone but includes various technologies that assist students in the learning process, such as online learning platforms. These technologies continue to evolve, and one of the latest trends is the use of AI in education, such as ChatGPT. Learning with AI technology like ChatGPT can now be implemented with well-structured strategies [28]. Besides AI, remote learning or online learning has become an alternative in education. Therefore, various factors influencing learning improvement can be measured in research to advance education for both students and educators, one of which is cognitive engagement. Cognitive engagement is considered important to measure as it ensures that students are cognitively involved in the learning process.

This study presents findings on students' cognitive engagement, measured through both descriptive and inferential statistics. The descriptive statistics used include mean scores, standard deviation, and the total score from the Likert scale questionnaire. The overall mean score obtained from data collection was 3.47, indicating a moderate positive level of cognitive engagement among students, suggesting that knowledge of prompting techniques in using ChatGPT can enhance their cognitive engagement. Among the questionnaire indicators, Self-Regulation, specifically the sub-indicator Monitoring Progress, had the highest score of 4.01, indicating that students agreed that using prompting techniques helped them develop self-regulation skills, such as the ability to control, direct, and monitor their thinking to achieve learning goals with the given prompts. On the other hand, the indicator with the lowest score was Critical Thinking, scoring 2.50, where students indicated that using prompts and the complex yet responsive information provided by ChatGPT did not effectively encourage critical thinking during the learning process. This finding aligns with the reality that relying solely on ChatGPT does not seem to enhance students' critical thinking unless supported by guided learning strategies led by educators to stimulate deeper thought. Further research is needed on the role of critical thinking in using ChatGPT with prompting techniques. However, previous studies suggest that critical thinking tends to develop positively in students during learning processes that integrate AI and large language models (LLMs) in higher education [29].

## 4. DISCUSSION

Cognitive engagement theory refers to the idea that learning is most effective when students are actively involved in meaningful processing of learning information, rather than just passively receiving it [30]. Learning becomes crucial in the process of developing students' knowledge through active learning strategies that encourage students to engage cognitively. Students learn through active questioning and exploration to achieve the learning key for each group's learning topic and this learning approach also incorporates the theory of constructivism, where learning is achieved as students actively construct their own knowledge through engagement. In this study, positive student cognitive engagement was observed through AI-based learning using ChatGPT, as measured by the indicators in the designed questionnaire. This

outcome is likely influenced by several factors, including the use of advanced technology, which appears to enhance students' engagement during the learning process which lead to positive cognitive engagement [31]. However, based on previous study it remains essential to implement effective learning strategies to fully support and optimize this AI-based learning approach [32].

This study focuses on the use of prompting techniques in student learning, where students apply specific prompts to achieve meaningful outcomes related to the learning topic. The prompting techniques used by students in this study included four different types, each with distinct purposes or contexts of use. This highlights that the appropriate and contextually relevant application of prompting techniques can positively impact cognitive engagement. This argument is supported by previous studies, which have shown that using prompting in AI-based learning can lead to positive learning outcomes, reinforcing the importance of well-structured prompts in enhancing student engagement [17]. As demonstrated in this study, cognitive engagement is reflected in self-regulation, depth of processing, and the quality of students' responses while learning new material presented in the research. Additionally, students demonstrated an improvement in using ChatGPT with the application of prompting techniques, which enhanced the quality and direction of ChatGPT's responses. This is believed to have increased students' cognitive engagement, as they received high-quality and focused responses from ChatGPT, which improved their focus and cognitive involvement in the learning process [33].

Future research should explore the broader impact of prompting techniques beyond cognitive engagement, extending the study to other widely used AI chatbots in education. A key limitation of this study is its small sample size, which focused solely on high school students. Expanding the scope to include multiple educational levels would provide a more comprehensive understanding of AI-assisted learning. Additionally, advancements in AI analytics, such as analyzing ChatGPT interaction logs, could offer deeper insights into students' learning needs and challenges, enabling a more personalized learning experience. Future studies could also adopt a longitudinal approach to assess the long-term effects of prompting techniques in AI-based learning, particularly their influence on critical thinking and knowledge retention in AI-based learning environments.

## 5. CONCLUSION

This study examined students' cognitive engagement when using prompting techniques in ChatGPT, as well as ChatGPT's role in student learning. The findings indicate that effective prompting techniques enhance cognitive engagement, allowing students to interact with AI more meaningfully. Additionally, students primarily perceive ChatGPT as a learning assistant and an information provider. However, their understanding of prompting techniques remains limited, suggesting a need for better guidance in utilizing AI tools effectively. Despite this, the study highlights that ChatGPT usage among students is relatively high, particularly for completing academic tasks. These results emphasize the importance of structured prompting strategies to ensure AI-generated responses align with students' learning goals. Future research should explore methods to improve students' prompting skills, maximizing the potential of AI-based learning.

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