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STUDENTS' CREATIVE THINKING PROCESS IN SOLVING MATHEMATICS PROBLEMS ASSISTED BY CHATGPT REVIEWED FROM SELF-EFFICACY

Astin Anas [1]*, Masriyah [2], Abdul Haris Rosyidi [3]
[1, 2, 3] Master's Program in Mathematics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, Indonesia
E-mail: 24030785003@mhs.unesa.ac.id [1]*, masriyah@unesa.ac.id [2], abdulharis@unesa.ac.id [3]

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Abstract

Creative thinking is an essential component of mathematical problem solving, yet its development remains underexplored, particularly regarding how students with different self-efficacy levels engage in creative thinking processes during ChatGPT-assisted mathematical problem solving. This study aimed to describe the creative thinking processes of students with high, moderate, and low self-efficacys in solving mathematical problems assisted by ChatGPT. A descriptive qualitative approach was employed, involving three Grade XI students selected through purposive sampling to represent high, moderate, and low self-efficacys categories with equivalent mathematical abilities. Data were collected through self-efficacy questionnaires, mathematical problem-solving tasks, interviews, and then analyzed using interactive qualitative analysis with time triangulation. The results showed that students across all self-efficacy levels completed the stages of preparation, mini-incubation, illumination, and verification. However, differences emerged in their levels of independence, idea development, and depth of verification; student with high self-efficacy demonstrated more independent and reflective thinking processes than those with moderate and low self-efficacy. These findings indicate that self-efficacy influences the quality of students' creative thinking processes when utilizing ChatGPT for mathematical problem solving.

Keywords: Creative Thinking Process; Mathematical Problem Solving; Self-Efficacy; ChatGPT; Artificial Intelligence

INTRODUCTION

Twenty-first-century education requires students to possess various high-level thinking skills, commonly known as Higher Order Thinking Skills (HOTS), one of which is creative thinking. In the context of mathematics learning, creative thinking is an indispensable competency because solving mathematical problems requires students to think flexibly and logically, enabling them to develop alternative solutions. Mathematics serves not only as a means to obtain correct answers but also as a vehicle to develop thinking and reasoning skills (Khatimah et al., 2017; Susanto, 2013), with problem-solving acting as one of the core components of learning (National Council of Teachers of Mathematics, 2000; Pehkonen, 1997). Therefore, creative thinking and problem-solving skills are two interrelated and inseparable aspects of mathematics education.

Nevertheless, various studies showed that the development of creative thinking processes in a student are still not a primary focus in mathematics learning. Teachers tend to focus more on final results rather than the thinking processes a student undergoes when solving problems (Jagom et al., 2021; Kafiar et al., 2015). Consequently, a student becomes accustomed to receiving information passively and is less trained in independently generating ideas or solution strategies (Permatasari et al., 2023; Wasahua, 2021). This condition is reflected in the low creative thinking abilities of a student, which are characterized by difficulties in generating diverse ideas, producing alternative solutions, and developing original approaches to solving mathematical problems.

The thinking process not only describes the final results obtained by a student but also demonstrates how the student understands a problem, considers various alternatives, and makes decisions to determine a solution. According to Suryabrata (2015), the thinking process comprises three main stages: forming understandings, forming opinions, and drawing conclusions; these stages can be used to describe how a student processes information and generates solutions when solving mathematical problems (Yanuirism & Rahaju, 2023). In this study, the creative

thinking process is examined through problem-solving in arithmetic sequences and series. This topic was chosen because of its systematic and contextual characteristics, which allow for the emergence of diverse solution strategies. Consequently, it can be utilized to identify how a student develops ideas, recognizes patterns, and makes generalizations when solving mathematical problems (Krisdarani et al., 2024; Silaban et al., 2022). Along with the development of digital technology, the process of solving mathematical problems no longer occurs solely through interactions between a student and a teacher, but also involves various Artificial Intelligence (AI)-based technologies. One of the innovations currently widely used is ChatGPT, an AI technology capable of providing interactive responses and supporting the student's learning process. Several studies showed that the use of ChatGPT can help a student understand mathematical concepts, improve problem-solving skills, and encourage the development of creativity and independent learning (Auna & Hamzah, 2024; Buton et al., 2025; Putri et al., 2025). In addition to providing direct feedback, ChatGPT also has the potential to act as a thinking partner that facilitates the exploration of various alternative solutions to mathematical problems.

However, the effectiveness of the students' creative thinking process in solving mathematics problems assisted by ChatGPT is not solely determined by cognitive factors, affective factors also play a critical role in shaping how student leverage this technology. In mathematics education, one of the most vital affective factors to consider is self-efficacy—defined as an individual's belief in their capability to execute tasks or overcome specific challenges. A robust body of literature demonstrates that self-efficacy is positively correlated with student problem-solving abilities and mathematical performance (Chan & Abdullah, 2018; Jatisunda, 2017; Li et al., 2020; Nurseha & Apiati, 2019). Consequently, when reviewed from their self-efficacy levels, student with high self-efficacy tend to exhibit greater persistence, a willingness to explore novel strategies, and a higher capacity to persevere through difficulties compared to those with low self-efficacy (Santrock, 2009; Yulianto, 2021).

Previous research has established that self-efficacy plays a pivotal role in fostering creative thinking and mathematical problem-solving. For instance, Yulianto (2021) found that self-efficacy significantly contributes to students' creative thinking abilities, while Khatimah and Fatmah (2019) demonstrated distinct variations in the creative thinking process between individuals with high and low self-efficacy. Furthermore, Citrawati et al. (2025) revealed that integrating Artificial Intelligence (AI) into mathematics learning can support creative thinking skills based on students' self-efficacy levels. However, existing studies predominantly focus on conventional learning environments or alternative AI technologies rather than ChatGPT. Moreover, they tend to examine creative thinking performance as an end result rather than analyzing the actual creative thinking process that unfolds during mathematical problem-solving. Consequently, a notable research gap remains regarding how students' creative thinking processes take place in solving mathematics problems assisted by ChatGPT, and how this process differs when reviewed from different levels of self-efficacy. Understanding the real-time creative thinking process during student-AI interactions is essential to provide a deeper understanding of ChatGPT's role in mathematics education, particularly in facilitating mathematical problem-solving.

Therefore, this study aims to describe the students' creative thinking process in solving mathematics problems assisted by ChatGPT, specifically when reviewed from high, medium, and low levels of self-efficacy. This research is expected to offer significant theoretical and practical contributions. Theoretically, it enriches the literature on the creative thinking process within mathematics education in the era of artificial intelligence. Practically, it provides actionable insights for educators in designing mathematics learning frameworks that effectively leverage ChatGPT while accounting for students' distinct self-efficacy characteristics.

LITERATURE REVIEW

The students' creative thinking process is a cognitive endeavor wherein individuals receive and process data to generate novel ideas aimed at problem-solving. In mathematics education, this dynamic process is not merely confined to finding a final solution; rather, it encompasses how students discover, develop, and modify ideas by leveraging their prior knowledge and experiences (Cahyati & Siswono, 2022). Consequently, this process serves as a foundational precursor to solving mathematical problems, as it systematically involves gathering information, evaluating problems comprehensively, and formulating creative alternative solutions. By exploring these divergent pathways, students are afforded the intellectual space to discover a multitude of non-linear solutions, thereby enhancing both the flexibility and effectiveness of their mathematical problem-solving strategies (Jatmiko, 2023). Mathematical problem-solving extends beyond the mere accuracy of final answers; it fundamentally requires the capacity to decompose complex problems into manageable components and formulate creative solutions. In this regard, ChatGPT offers substantial pedagogical support by providing abstract concept simulations, personalized feedback, and adaptive learning environments. Consequently, integrating ChatGPT-assisted learning can

significantly enhance students' creative thinking processes in solving mathematics problems (Citrawati et al., 2025). The integration of ChatGPT into mathematics education facilitates a personalized and contextualized learning experience, thereby enhancing student engagement and academic motivation. Within this technology-assisted environment, self-efficacy plays a central role. Students who possess high self-efficacy regarding their mathematical capabilities tend to exhibit greater resilience against challenges, employ diverse problem-solving approaches, and confidently test novel strategies. This is further reinforced by Mutia et al. (2024), whose findings demonstrate that self-efficacy correlates significantly with mathematical creative thinking, directly supporting the resolution of complex tasks. Consequently, fostering self-efficacy emerges as a pivotal determinant in optimizing the students' creative thinking process in solving mathematics problems assisted by ChatGPT.

This interactive learning experience enables students with varying levels of self-efficacy to experiment and innovate during problem-solving without the fear of failure. Such an environment ultimately fosters cognitive resilience and enhances mathematical confidence. According to Bandura (1997), a high level of self-efficacy correlates with increased academic effort and perseverance when facing challenges. Empirically, Wahyu (2021) demonstrated that self-efficacy contributes 20.44% to creative thinking, indicating that an increase in self-efficacy significantly yields higher creative thinking capacities in mathematics. Consequently, fostering student self-efficacy is a fundamental prerequisite for cultivating creative thinking processes and mathematical problem-solving skills. Furthermore, Hakim (2021) noted that while psychological factors heavily dictate learning outcomes, external scaffolds are equally essential; thus, ChatGPT serves as a supportive tool that reinforces these psychological domains. In conclusion, the creative thinking process and mathematical problem-solving are profoundly influenced by self-efficacy, which can be further amplified through interactive, AI-driven learning. ChatGPT acts as an innovative facilitator designed to maximize students' potential, deliver contextualized learning experiences, and enhance the quality of contemporary mathematics education. Therefore, this study aims to describe the students' creative thinking process in solving mathematics problems assisted by ChatGPT, specifically when reviewed from high, medium, and low levels of self-efficacy.

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METHOD

Approaches and Types of Research

This study employs a descriptive qualitative approach to investigate the students' creative thinking process in solving mathematics problems assisted by ChatGPT, particularly when reviewed from self-efficacy perspectives. A qualitative framework is utilized to gain a profound, comprehensive understanding of the phenomena based on the subjects' lived experiences and activities within a natural context (Moleong, 2018). The primary research data consist of descriptive accounts gathered through multiple sources, including questionnaires, mathematical problem-solving tests, semi-structured interviews, and documentation, all aimed at meticulously capturing the nuances of the students' creative cognitive processes.

Data Source

The data sources for this study were eleventh-grade (XI) high school students who had completed instruction on arithmetic sequences and series. Subjects were selected using a purposive sampling technique to ensure participants met specific characteristics aligned with the research objectives. The selection process was executed in three sequential stages: (1) grouping students based on their self-efficacy levels using a questionnaire, (2) identifying equivalent mathematical proficiency via the Mathematical Ability Test (MAT), and (3) verifying baseline proficiency in utilizing ChatGPT through the first Problem-Solving Task (PST 1). This selection process yielded three distinct subjects representing high, medium, and low self-efficacy categories, all demonstrating equivalent mathematical abilities, as detailed in Table 1. Subsequently, these three subjects were given the second Problem-Solving Task (PST 2) and underwent semi-structured interviews to extract comprehensive data regarding their students' creative thinking process in solving mathematics problems assisted by ChatGPT.

Table 1. Research Subject

No.	Student Name	Categories of Math Ability	Categories Self-Efficacy
1.	CAR	Medium	Height
2.	NER	Medium	Medium
3.	AENS	Medium	Low

Data Collection Techniques & Instruments

This study utilized a self-efficacy questionnaire, the Mathematical Ability Test (MAT), Problem-Solving Tasks (PST), and semi-structured interviews as data collection instruments. The self-efficacy questionnaire was developed using a Likert scale framework to measure students' attitudes, opinions, and self-perceptions based on predetermined indicators (Situmorang & Lutfi, 2014); the scores were subsequently used to classify students into high, medium, and low self-efficacy cohorts. Concurrently, the MAT was administered to identify students with equivalent mathematical proficiency, a factor considered alongside communication skills and baseline ChatGPT usage during subject selection. Following the subject selection, PST 1 was deployed to elicit empirical data on the students' creative thinking process in solving mathematics problems assisted by ChatGPT. To ensure data credibility and reliability, this study employed PST 2 which possessed an equivalent difficulty level to PST 1 as a time-triangulation technique administered one week after the initial task. To supplement the written tests, semi-structured interviews were conducted immediately following each PST session to delve deeper into the students' creative cognitive phases, specifically capturing nuances not adequately revealed in their written responses. The entire interview process was audio-recorded, transcribed verbatim, and utilized as primary supporting data in the qualitative analysis

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Validity of Research Results

Given the qualitative nature of this study, establishing the credibility of the findings was imperative to ensure data trustworthiness. In this study, the researcher evaluated data credibility utilizing time triangulation. Through this method, the study aimed to verify the consistency, alignment of perspectives, and cognitive flow of the subjects across different times and distinct sessions. Accordingly, data collection was executed in two separate phases with a one-week interval. The data were deemed valid when they demonstrated robust consistency between the first and second collection phases. This consistency encompassed congruence among the subjects' written test results, orally expressed insights, and observable behaviors during the interviews across both sessions. Consequently, only the data proven valid were advanced to the subsequent stage of qualitative analysis.

Data Analysis Techniques

This study applied an interactive and continuous qualitative data analysis technique, which was executed iteratively until data saturation was achieved. The systematic stages of the data analysis were structured as follows:

1. Data Analysis of Self-Efficacy Questionnaire Results

Quantitative analysis of the student self-efficacy questionnaire involved computing the cumulative score for each participant, followed by determining the mean and standard deviation. Prior to these statistical computations, the raw ordinal responses were converted into interval data to ensure robust parametric comparison. The final derived values determined the specific self-efficacy levels of the students. The scoring mechanism for the self-efficacy instrument was based on a Likert scale framework, as detailed in Table 2.

Table 2. Self-Efficacy Questionnaire Assessment Scale

Alternative Answers	Statement Assessment	
	Positive	Negatives
Strongly agree	4	1
Agree	3	2
Disagree	2	3
Strongly Disagree	1	4

The primary objective of this data analysis was to determine the students' self-efficacy levels. Utilizing the calculated means and standard deviations from the questionnaire responses, the subjects were classified into three distinct categories: high, medium, and low self-efficacy. The statistical criteria applied to establish these stratification levels are formulated in Table 3.

Table 3. Classifying Student Self-Efficacy

Student Self-Efficacy Level	Criteria
Height	Students who have self-efficacy scores≥x+S
Medium	Students who have x-S<a self-efficacy score <x+S
Low	Students who have self-efficacy scores≤x-S

Description:

$\bar{x}$: Average

S : Standard Deviation

2. Data Analysis of Mathematical Ability Test Results (MAT)

Data from the MAT were evaluated against the established answer key to calculate and analyze the individual scores. The resulting performance data were then ranked in descending order, from the highest to the lowest scores. Following the grading process, the researcher initiated a preliminary screening to select prospective research subjects by concurrently examining their MAT performance and self-efficacy profiles. At this stage, the candidates were stratified according to their mathematical competence levels prior to the final selection of the primary research subjects.

3. Data Analysis of Mathematical Problem Solving Tasks (PST)

Data derived from the Problem-Solving Task (PST) were analyzed using specific creative thinking process indicators. These metrics encompassed four distinct operational stages: preparation, brief incubation, illumination, and verification, as detailed in Table 4.

Table 4 Indicators of the Creative Thinking Process

Stages	Indicator
Preparation (P)	• Defining and formulating the problems (P1) • Collecting and associating relevant information (P2)
Mini Incubation (MI)	• Processing problem-solving ideas subconsciously (MI1) • Selecting the most appropriate problem-solving strategy (MI2) • Structuring the execution plan based on the chosen strategy (MI3)
Illumination (IL)	• Generating new insights or innovative problem-solving ideas (IL1) • Solving the problems systematically according to the pre-selected strategy (IL2)
Verification (V)	• Testing and verifying the obtained solutions or results (V1) • Cross-checking the results utilizing alternative problem-solving methods (V2)

The collected data were presented in the form of structured, descriptive narratives. This data display encompassed systematic classification and identification aligned with the predetermined indicators of the creative thinking process, thereby facilitating the derivation of robust conclusions based on the empirical evidence.

4. Analysis of Interview Data

The interview data were processed to ensure they were ready for subsequent qualitative analysis. The data processing procedure involved three primary steps: (1) subjects were asked to provide a verbal account of their creative thinking processes during problem-solving tasks assisted by ChatGPT; (2) audio recordings were captured throughout each interview to document the subjects' explanations; and (3) these audio recordings were transcribed verbatim. This systematic approach ensured synchronization between the raw audio data and the written transcripts, allowing the researcher to verify the accuracy of the transcripts against the original recordings.

5. Data Presentation

Data display can be executed through brief descriptions, charts, flowcharts, or network diagrams representing relationships between categories (Sugiyono, 2009). The primary objective of displaying data is to organize and synthesize empirical information into structured relational patterns, thereby facilitating the resolution of the research questions. In this study, the data were presented through narrative texts structured into five sequential steps: (1) presenting the results of the student self-efficacy questionnaire as the baseline for subject selection; (2) displaying the MAT scores to identify subjects with equivalent mathematical proficiency; (3) documenting the PST performance of each selected subject; (4) reporting the qualitative interview outcomes; and (5) articulating the analytical findings that delineated each student's creative thinking process in solving mathematical problems assisted by ChatGPT.

6. Conclusion

The final stage in the qualitative data analysis involved drawing conclusions, a critical phase that directly addresses the primary research questions. The conclusions derived in this study synthesized the outcomes of the Problem-Solving Task (PST) and the semi-structured interviews, which were previously evaluated against specific creative thinking indicators. The overarching objective of this concluding stage was to delineate a comprehensive overview of students' creative thinking processes during ChatGPT-assisted mathematical problem-solving, as examined through the lens of their respective self-efficacy levels.

RESULTS AND DISCUSSION

Creative Thinking Processes of Students with High Self-Efficacy (HSE) in ChatGPT-Assisted Mathematical Problem-Solving

The creative thinking process of the HSE student in ChatGPT-assisted mathematical problem-solving was identified through the written responses to the PST and the subsequent interview results. The following presents the written response of the HSE student to PST 1.

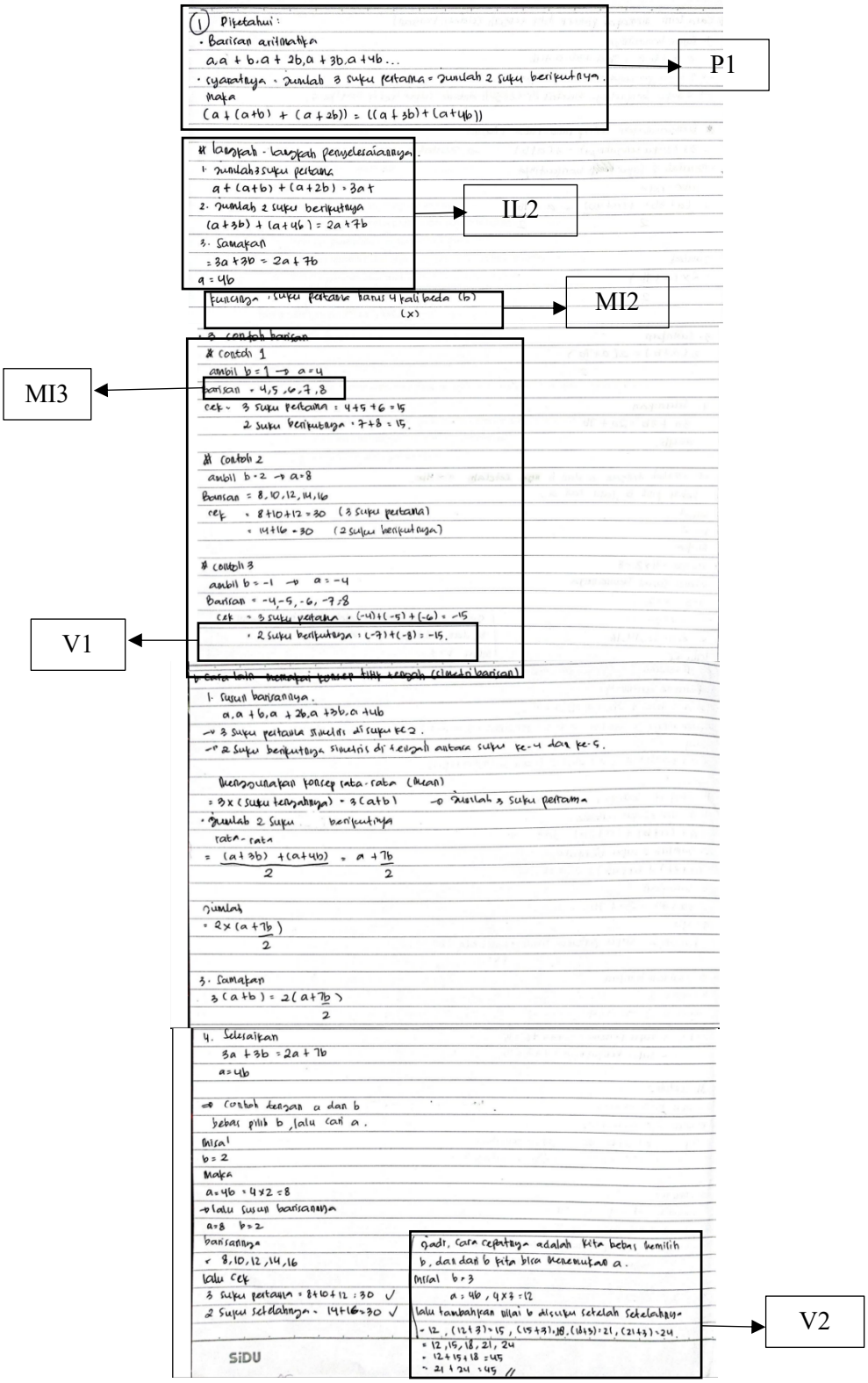


Figure 1. Subject HSE's Response to the PST 1

The following presents the interview excerpt of the HSE student regarding PST 1.

Label	Transkip Wawancara	Kode
PTT101	Dari soal TPM yang sudah dikerjakan, pada saat membaca soalnya apa yang pertama kali kamu pikirkan?	
STT102	Kemarin itu saya langsung ke ChatGPT-nya, lalu saya pahami lagi. Saya agak kurang paham dengan cara yang pertama, tetapi di nomor dua kan diminta menggunakan cara lain. Sepertinya cara itu lebih mudah, jadi sambil saya jelaskan di sini (lembar jawaban tertulis)	P1
PTT103	Saat membaca soal yang kemarin, kamu sempat membacanya berulang kali gak?	
STT104	Nggak, langsung saya masukkan ke ChatGPT-nya	P1
PTT105	Oke. Lalu saat mau menjawab soalnya, perintah atau prompt apa yang kamu berikan ke ChatGPT?	
STT106	Perintahnya lebih ke arah minta dijelaskan secara rinci saja, supaya lebih mudah dipahami	P2
PTT109	Berarti langsung difoto soalnya, dimasukkan ke ChatGPT, lalu diminta penjelasan secara rinci?	
STT110	Iya	P2
PTT115	Terus saat ChatGPT memberikan jawaban cara pertama dan cara kedua kemarin, kamu langsung setuju atau sempat ragu dan membandingkannya dengan pemahaman kamu sebelumnya?	
STT116	Sempat ragu, jadi saya bandingkan dulu	IN1
PTT117	Benar tidak ya jawabannya? Takutnya nanti ChatGPT memberikan jawaban yang tidak sesuai	
STT118	Iya, kadang ada salahnya juga. Jadi harus dibaca baik-baik jawabannya	IN1
PTT119	Terus, sempat merasa sulit memahami cara pertama. Langkah apa yang kamu ambil untuk mencoba memahami cara tersebut?	
STT120	Yang saya coba pahami itu cara yang kedua, Kak. Langkah-langkahnya lebih mudah dipahami dan lebih gampang masuk ke pikiran daripada cara yang pertama.	IN1
PTT123	Apakah sempat mencoba beberapa kali mengganti prompt di ChatGPT-nya?	
STT124	Iya, dan di situ muncul banyak pilihan jawaban, seperti cara ini dan cara itu. Akhirnya saya pilih yang titik tengah ini karena lebih mudah	IN2
PTT127	Terus saat melihat jawaban dari ChatGPT, baik cara pertama maupun cara kedua, apakah sempat muncul ide baru untuk memodifikasi barisannya atau mungkin jawabannya muncul ide baru enggak buat memodifikasi barisannya atau mungkin jawaban-jawaban yang lain?	
STT128	Coba buat barisan yang baru juga	IL1

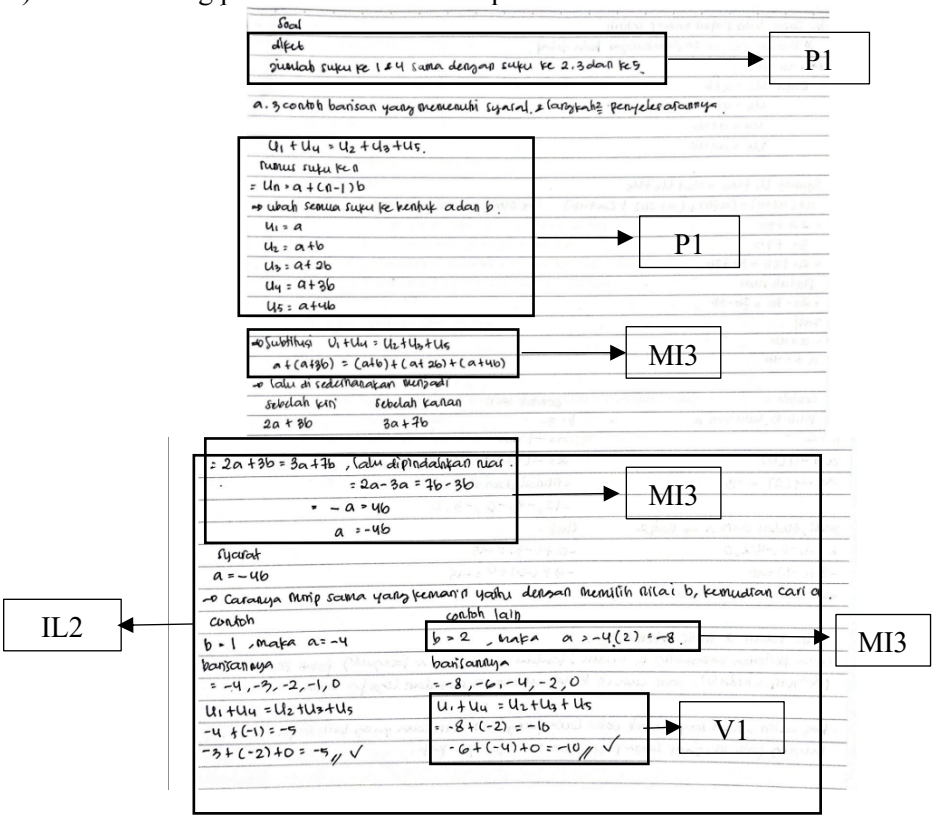
PTT129	Oke. Terus, pas dikasih pilihan jawaban sama ChatGPT, gimana cara kamu nyari cara atau penyelesaian yang cocok untuk jawaban dari soal yang diberikan?	
STT130	Aku nyuruh ChatGPT buat cari cara lain, yang lebih bisa aku pahami	IL2
PTT133	Terus, saat kamu menjawab soalnya, bagaimana akhirnya kamu yakin bahwa jawaban dari ChatGPT itu benar?	
STT134	Karena dari konsep ini saya sangat paham, Kak. Kemarin itu kan kita bisa pilih bedanya, lalu cari a-nya. Jadi terasa lebih mudah daripada cara awal yang mengharuskan kita menjumlahkan dulu semua sukunya dan menyamakan kedua sisinya	V1
PTT135	Terus kalau misalnya ternyata jawabannya salah, bagaimana?	
STT136	Biasanya kalau di AI begitu, saya cross-check lagi Kak, untuk memastikan mana yang benar	V1
PTT137	Oke, di-cross-check lagi. Sempat mencoba mengingat kembali pembelajaran tentang barisan aritmatika ini tidak? Misalnya berpikir, "Kayaknya penjelasan guru atau yang di buku tidak seperti ini, ini agak keliru," pernah merasa begitu?	
STT138	Iya Kak, sambil nyari referensi lain	V2
PTT139	Kalau ChatGPT ngasih jawaban yang sama ke temen-temen kamu yang lain, itu gimana cara kamu buat jawabannya beda dari temen-temen kamu yang lain?	
STT140	Kan caranya banyak tuh, aku milih cara yang bakalan gak dipake sama temen-temen.	V2
PTT141	Kamu sempat buktikan gak, kalau misalnya cara yang dikasih sama ChatGPT ini polanya bisa kamu gunakan ke soal yang lain, dengan tipe soal yang sama?	
STT142	Bisa kok kak, pakai konsep titik tengah nanti kita tinggal sesuaiin sama syarat soalnya, nanti dapet beda sama a-nya, terus disubstitusi dan dapat barisannya.	V2
PTT143	Dari jawaban yang kamu tulis ini, kamu full ChatGPT atau gimana?	
STT144	Cara pertama itu ChatGPT, sampai akhirnya aku pahamin dan nemuin beda sama a-nya, akhirnya aku kerjain sendiri sampai dapat barisannya.	V2

Based on the written responses of the HSE student in Figure 1 and the interview excerpt from PST 1 above, information regarding the student's creative thinking process was obtained as follows, in the preparation stage, the HSE student did not initially demonstrate autonomous problem formulation prior to utilizing ChatGPT. Upon encountering the problem, the student immediately uploaded an image of the prompt to ChatGPT to seek detailed explanations due to an initial lack of conceptual clarity (STT102, STT104, STT106, STT110) and strategic foresight (STT112, STT114). However, after receiving AI-generated explanations, the student successfully identified relevant information and formulated mathematical models, as evidenced by the written responses outlining the general formula for arithmetic sequences and establishing the necessary mathematical representations (P1). Consequently,

while the preparation stage was fully realized, ChatGPT functioned as a critical cognitive scaffold that enabled the student to identify core constraints and synthesize mathematical models from the given problem. In the mini-incubation stage, the HSE student demonstrated active cognitive processing through the evaluation, comparison, and selection of potential solutions generated by ChatGPT. Prompted by initial skepticism regarding the AI's output, the student systematically requested alternative methods by entering the prompt, "Apa ada cara lain yang lebih kompleks? Jelaskan langkah-langkahnya juga" (STT116, STT118, STT124). Rather than passively accepting the AI's data, the student internally evaluated these alternatives and deliberately selected the midpoint concept (konsep titik tengah) as the most accessible strategy (STT120, STT122). This critical selection process is supported by the student's written response, which reflects a coherent, structured execution of the chosen strategy to determine the initial term of the sequence (IN3). Ultimately, the mini-incubation stage was successfully achieved, with ChatGPT serving as an ideological repository while the student maintained full cognitive control over strategy selection.

In the illumination stage, the HSE student demonstrated conceptual insight and generative thinking after gaining a clear understanding of the chosen strategy. Using ChatGPT to explore multiple alternatives, the student identified a more accessible method and independently advanced the problem-solving process to determine the common difference (beda) and the initial term of the sequence (STT126, STT130, STT144). Rather than merely replicating the AI's output, the student actively generated novel mathematical examples based on the newly acquired concept (STT128). This deep understanding is verified by the written responses, which show the student constructing distinct sequence variations (IL2) and calculating them to prove they satisfied the problem constraints. Consequently, the illumination stage was fully realized as the student successfully transitioned from AI-facilitated scaffolding to autonomous conceptual mastery and creative idea generation.

In the verification stage, the HSE student demonstrated rigorous, autonomous evaluation by cross-checking, testing, and confirming the validity of the mathematical solution. Driven by critical skepticism, the student routinely reviewed ChatGPT's calculations (STT132, STT136), sought external reference materials to ensure conceptual alignment with arithmetic sequence principles (STT138), and consciously selected distinct strategies to differentiate their work from peers (STT140, STT142). This analytical depth is corroborated by the written responses (V1), where the student systematically validated each sequence variation by summing the terms to ensure they satisfied the problem constraints. Rather than passively accepting the AI's output, the student treated ChatGPT merely as an initial baseline, successfully realizing the verification stage through comprehensive self-directed triangulation and strategic transferability (STT134). The following presents the written response of the HSE student to PST 2.



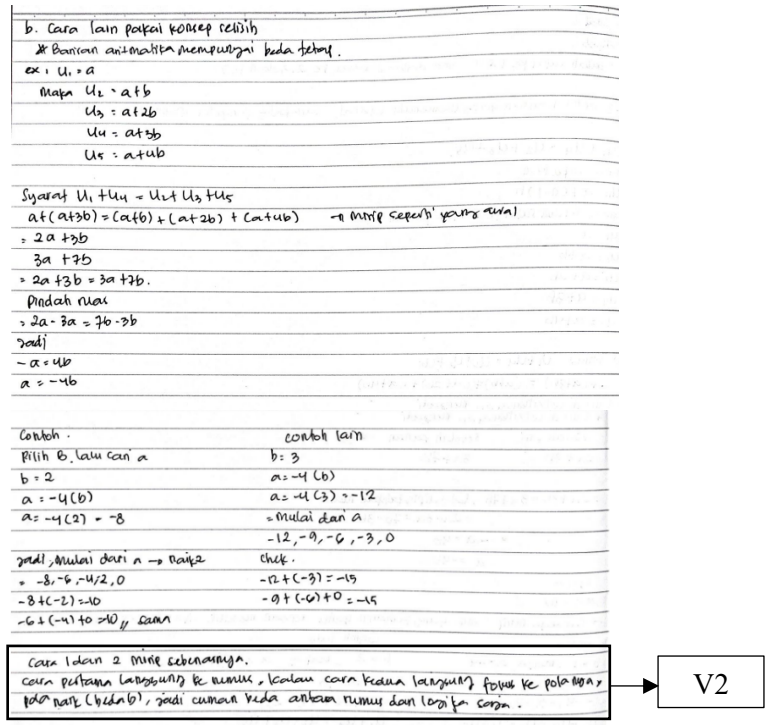


Figure 2. Subject HSE's Response to the PST 2

The following presents the interview excerpt of the HSE student regarding PST 2.

Label	Transkip Wawancara	Kode
PTT245	Pas kamu lihat soalnya, kamu langsung terpikir apa? Mau langsung mengerjakan lewat ChatGPT atau mungkin sempat terbayang ke pengerjaan kemarin?	
STT246	Terbayang ke yang kemarin sih, Kak, yang bisa dipakai di soal lain. Yang kemarin itu kan bisa dipakai di soal lain, kayak soal yang ini contohnya. Terus coba cross-check saja ke ChatGPT, apakah sama atau tidak hasilnya	P1
PTT249	Berarti prompt-nya sama kayak yang kemarin, atau ada yang berbeda?	
STT250	Sama	P2
PTT257	Berarti kamu tidak mencoba beberapa kali prompt ke ChatGPT? Cuma sekali saja?	
STT258	Beberapa kali, tapi dari cara yang aku cari itu, yang lebih aku pahami itu yang dua ini	IN1
PTT259	Oh, yang dua itu? Jadi lebih pilih yang mudah saja? Jadi cari yang gampang buat dipahami. Oke. Terus kalau misalnya tadi dikasih jawaban sama ChatGPT, kamu sempat terpikir ide lain tidak? Misalnya, "Oh, ini ChatGPT sudah menjawab, aku mau buat barisan sendiri deh," atau "Aku mau modifikasi sendiri barisan yang dikasih."	
STT260	Tidak, langsung ambil dari ChatGPT-nya saja	IL2
PTT261	Berarti sudah langsung pas, ya? Terus, tadi sebelum bertanya ke ChatGPT, kan sudah terbayang jawabannya kurang lebih sama	

	seperti yang kemarin. Sempat dihitung ulang tidak?	
STT262	Iya, dihitung ulang	V1
PTT263	Terus kalau misalnya ternyata jawaban yang dikasih sama ChatGPT salah, bagaimana?	
STT264	Aku coba suruh bikin beberapa contoh sih, Kak, buat memastikan lagi. Terus nanti dihitung ulang lagi.	V1
PTT267	Terus kalau misalnya ternyata jawaban yang kamu dapat dari ChatGPT ini sama dengan teman-temanmu yang lain, ada terpikir untuk mengubahnya atau tetap mau dijawab seperti itu saja?	
STT268	Tetap dijawab itu saja, soalnya lebih paham yang seperti itu, tapi barisannya saya ubah agar tidak sama	V2

Based on the written responses of the HSE student in Figure 2 and the interview excerpt from PST 2 above, information regarding the student's creative thinking process was obtained as follows, in the preparation stage, the HSE student demonstrated proactive problem formulation by anchoring the new task in prior cognitive experiences and utilizing ChatGPT to validate their initial schema. Upon reading the prompt, the student immediately recognized its underlying mathematical structure and connected it to a previously solved analogue (STT246). Confident in this conceptual continuity, the student deployed the identical photo-based prompt, "Jelaskan secara rinci," to confirm their baseline understanding (STT250). Despite encountering distinct problem constraints, the student seamlessly navigated the AI's feedback without cognitive friction (STT252, ST2T254, STT256). This robust integration is reflected in the written responses (P1), where the student systematically modeled the problem according to the new parameters. Consequently, the preparation stage was fully achieved, with ChatGPT functioning as a secondary cognitive support that reinforced and refined the student's pre-existing mathematical frameworks.

In the mini-incubation stage, the HSE student demonstrated active selection and cognitive filtering by evaluating multiple solution pathways generated through iterative prompting. The student intentionally tested various prompts with ChatGPT to extract distinct strategic alternatives, deliberately selecting the two methods deemed most accessible (STT258). This active filtering is corroborated by the written responses (IN3), which display a structured execution of the selected methods. Although the foundational ideas originated from the AI rather than autonomous generation, the student retained cognitive control over the evaluation and strategic selection processes. Consequently, the mini-incubation stage was successfully realized, with ChatGPT serving as an ideological repository while the student executed the critical selection of the optimal mathematical path.

In the illumination stage, the HSE student achieved conceptual insight by synthesizing and adapting the various strategic pathways provided by ChatGPT. Interview data reveals that after extracting multiple solutions from the AI, the student successfully decoded the underlying logic and directly applied it to resolve the task, though without pursuing further autonomous modification (STT260). Within this phase, ChatGPT functioned as a critical instructional facilitator that catalyzed new understanding by presenting clear, alternative procedures. This conceptual acquisition is evident in the written responses (IL2), where the student executed a highly systematic, step-by-step resolution derived from the AI's scaffolding. Consequently, the illumination stage was successfully realized through the effective cognitive internalization and systematic application of the adapted strategy.

In the verification stage, the HSE student demonstrated analytical rigor by systematically validating and tailoring the mathematical solutions obtained. Interview data reveals that the student manually recalculated ChatGPT's outputs to ensure strict compliance with the problem constraints (STT262) and proactively prompted the AI for additional examples to cross-check results whenever skepticism arose (STT264). Furthermore, when encountering identical methods among peers, the student intentionally modified the underlying sequence variations to maintain originality while preserving the structural logic (STT266). This purposeful customization is corroborated by the written responses (V1), which display adapted sequence patterns. Consequently, the verification stage was fully realized through active recalculation, collaborative comparison, and deliberate solution tailoring rather than passive acceptance.

Creative Thinking Processes of Students with Medium Self-Efficacy (MSE) in ChatGPT-Assisted Mathematical Problem-Solving

The creative thinking process of the MSE student in ChatGPT-assisted mathematical problem-solving was identified through the written responses to the PST and the subsequent interview results. The following presents the written response of the MSE student to PST 1.

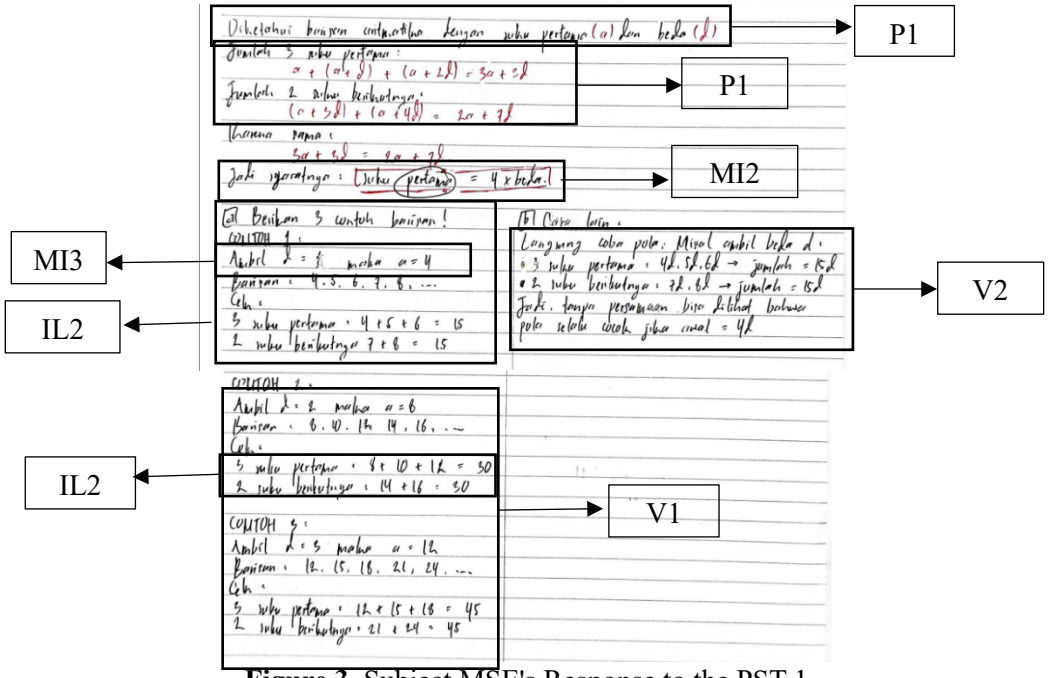


Figure 3. Subject MSE's Response to the PST 1

The following presents the interview excerpt of the MSE student regarding PST 1.

Label	Transkip Wawancara	Kode
PST171	Pada saat menjawab soal tadi, kamu gimana? Pas lihat soalnya kamu kepikiran apa?	
SST172	Sebenarnya yang pertama kali saya tanya ke ChatGPT itu jawabannya sudah ringkas dan sesuai yang saya mau. Cuma ada beberapa istilah itu saya masih kurang paham, seperti ini kan ada 'a' itu ternyata 'awal', 'd' itu ternyata 'beda'-nya ya. Tapi sama ChatGPT itu tidak dijelaskan, jadi saya tanya lebih lanjut	P1
PST173	Pas pertama kali membaca soalnya ini, langsung kepikiran mau pakai ChatGPT atau gimana?	
SST174	Sebenarnya masih mau mencoba-coba dulu Kak, karena kan materi barisan aritmatika kayak masih oke lah	P1
PST175	Tapi setelah dibaca, mungkin langsung kepikiran langsung ke ChatGPT saja gitu?	
SST176	Iya kak, langsung ke ChatGPT	P1
PST177	Pas mau kasih ke ChatGPT, kamu pakai prompt yang kayak gimana? Apa langsung kirim foto, masukin, atau ada instruksi arahan ke ChatGPT-nya kayak gimana?	
SST178	Saya kirim foto terus langsung ketik "jawab", sudah gitu	P2
PST181	Karena langsung setuju atau ragu ya sama jawabannya ChatGPT? Kamu juga sempat	

	coba dibandingkan sama pemahamannya kamu sendiri. Dari cara satu sama cara dua ini, ada tidak yang kamu bingung caranya, penjelasan dari ChatGPT-nya?	
SST182	Iya sempat ragu, dan gak ada yang bingung	IN1
PST183	Kalau misalnya beberapa dari penjelasan ChatGPT-nya bingung, kamu coba pahami atau mungkin coba cari maksudnya pakai prompt lain atau gimana?	
SST184	Iya, nyari pakai prompt lain. Jadi saya suruh jelaskan lagi maksud dari itu	IN1
PST187	Dari penjelasan yang dikasih sama ChatGPT, dari cara satunya sama cara duanya, ada tidak bagian yang akhirnya kamu kayak kepikiran "Oh ternyata soal ini bisa gunain pakai cara ini ya", ada tidak?	
SST188	Ada, cara duanya. Soalnya ternyata lebih ringkas dibandingkan cara satu	IL1
PST191	Berarti dari angka-angka yang dikasih sama ChatGPT juga berarti penuh langsung dari ChatGPT?	
SST192	Iya, full ChatGPT	IL2
PST197	Pada saat mengerjakan soalnya ini ke ChatGPT, kamu mikirnya kayak gimana? Ada kepikiran jawabannya ini benar atau tidak?	
SST198	Awalnya saya ragu-ragu Kak, iya. Jadi kayak saya coba menghitung, ini ada bekas pensilnya soalnya, tidak percaya	V1
PST1101	Kalau misalnya ternyata jawaban yang dikasih sama ChatGPT-nya salah, setelah kamu hitung "Oh ternyata jawabannya ini salah", itu kayak gimana?	
SST1102	Biasanya ChatGPT itu sudah benar secara cara dan rumus yang dikasih. Cuma biasanya angka-angkanya itu ada kesalahan sedikit. Jadi mungkin masih pakai rumus yang sama dari ChatGPT, cuma angkanya saya benarkan	V1
PST1105	Berarti kayak sudah ini saja, satu saja jawabannya. Gimana akhirnya kamu bisa yakin kalau misalnya pola ini bisa dipakai ke soal yang lain tapi dengan tipe yang sama?	
SST1106	Hitung sih. Dihitung lagi ya, kayak "Oh dari ChatGPT untuk yang tiga suku pertama sama dengan dua suku berikutnya dia pakai ini, aku mau ganti pakai yang empat suku". Dihitung sendiri.	V2

Based on the written responses of the HSE student in Figure 3 and the interview excerpt from PST 1 above, information regarding the student's creative thinking process was obtained as follows, in the preparation stage, the MSE student demonstrated initial attempts at autonomous problem formulation, which were ultimately limited by a lack of initial strategic foresight. Although the student initially intended to solve the task independently due to prior familiarity with arithmetic sequences (SST174), they quickly shifted to utilizing ChatGPT immediately after reading the prompt (SST176). The student deployed a rudimentary prompt, "jawab" (answer), without providing further context or direction, reflecting a minimal level of independent problem structuring and a lack of an initial conceptual blueprint (SST178, SST180). However,

the student actively sought to build conceptual clarity by prompting the AI to clarify specific mathematical notations, such as the symbols a and d (SST172). Consequently, while the preparation stage was achieved, the process remained heavily reliant on ChatGPT as an instructional source to decode foundational terminology rather than a tool for deeper independent formulation.

In the mini-incubation stage, the MSE student engaged in basic idea evaluation driven by an initial skepticism toward ChatGPT's output (SST182). When encountering conceptual difficulties, the student sought clarification by entering the follow-up prompt, "Jelaskan cara lain yang dimaksud" (SST184). However, this cognitive processing remained limited; the student neither generated independent solutions nor explored alternative strategies, relying instead on a single instructional path without developing further prompt variations (SST186). Within this phase, ChatGPT functioned merely as the primary source of initial ideas and explanatory scaffolding, while the student's role was confined to basic internal filtering.

In the illumination stage, the MSE student achieved a baseline level of insight by recognizing that the second strategy presented by ChatGPT was more concise than the first (SST188). Despite identifying this strategic efficiency, the student did not expand upon or modify the AI's framework to construct novel solutions (SST190, SST192). This passive adaptation is evident in the written responses (IL2), where the student systematically replicated the AI's step-by-step procedure to arrive at the final answer. Consequently, the illumination stage was characterized by a receptive understanding of a simpler strategy rather than the autonomous generation of new mathematical concepts.

In the verification stage, the MSE student demonstrated analytical monitoring by manually recalculating ChatGPT's final outputs due to a lack of complete trust in the AI's computational accuracy (SST198, SST1100). Recognizing that ChatGPT is prone to numerical errors, the student corrected the calculations while strictly maintaining the AI's conceptual formulas (SST1102). Furthermore, the student attempted to test the validity of the pattern by altering the problem constraints and recalculating the results independently (SST1106). Ultimately, while the verification stage was successfully realized through active numerical validation and constraint testing, it remained strictly bounded within the single, AI-provided strategic framework without any comparative triangulation.

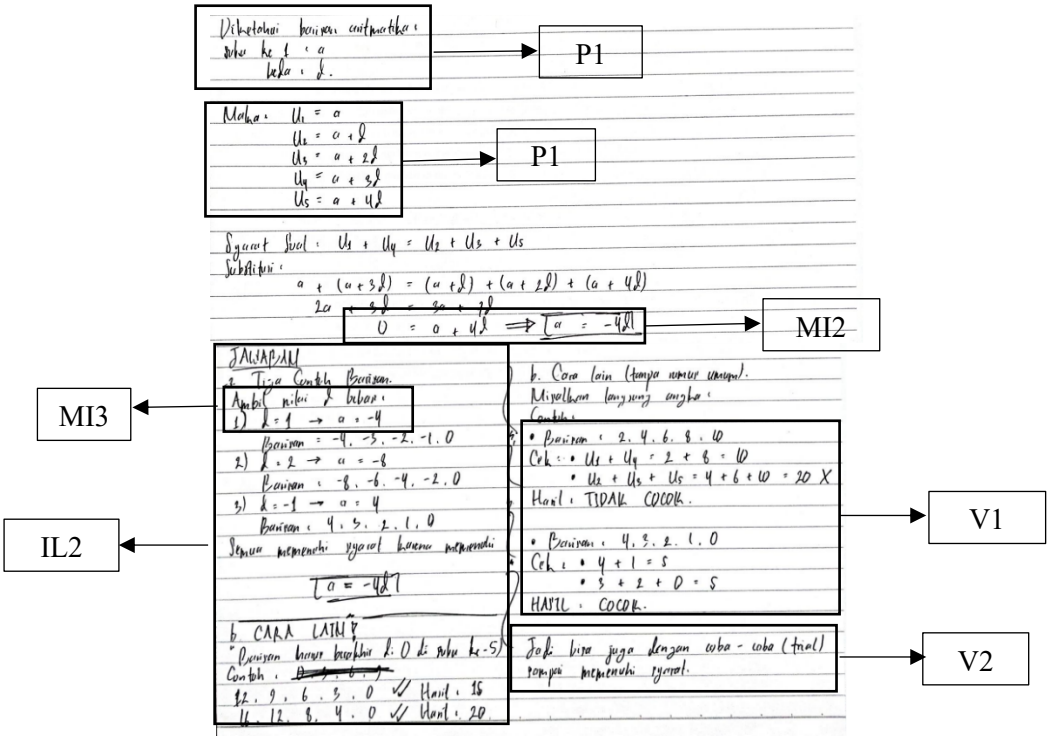


Figure 4. Subject MSE's Response to the PST 2

The following presents the interview excerpt of the MSE student regarding PST 2.

Label	Transkip Wawancara	Kode
PST2107	Tadi pas baca soalnya, kamu bagaimana? Apakah mau langsung mengerjakan sendiri atau langsung ke ChatGPT?	

SST2108	Belum kepikiran caranya, jadi langsung ke ChatGPT	P1
PST2109	Oh, belum kepikiran caranya bagaimana, jadi memilih untuk langsung ke ChatGPT-nya, ya. Prompt yang dikasih ke ChatGPT-nya apa?	
SST2110	Jawab saja. Jadi, foto soal langsung dikirim dan disuruh jawab	P2
PST2111	Oke. Ini kan syarat soalnya berbeda ya dari yang kemarin. Kalau yang kemarin kan Cuma dari jumlah tiga suku pertama sama dengan dua jumlah suku berikutnya. Kalau soal ini jumlah suku ke-1 dan ke-4, sama dengan jumlah suku ke-2, ke-3, dan ke-5. Ada prompt atau instruksi lain tidak yang kamu berikan ke ChatGPT?	
SST2112	Ada. Jadi di cara keduanya, ChatGPT malah menyuruh saya untuk mencoba angka random, dan ternyata ada hasil yang tidak cocok. Jadi, saya minta untuk cari cara lain	P2
PST2113	Terus, berarti tadi sempat ada jawaban dari ChatGPT yang kamu kurang setuju, ya?	
SST2114	Iya	IN1
PST2117	Sempat membandingkan dengan pemahamannya kamu atau bagaimana?	
SST2118	Iya sempat, jadi dibandingin sama jawaban dari ChatGPT-nya sampai paham dan setuju	IN1
PST2119	Ada kepikiran mau memodifikasi jawabannya tidak? Atau plek-ketiplek ambil dari ChatGPT?	
SST2120	Plek-ketiplek dari ChatGPT	IL2
PST2121	Oke, jadi instruksi tambahannya adalah cara yang itu kurang pas karena masih salah, jadi minta dibuatkan cara yang lain. Terus, akhirnya kamu yakin kalau jawaban yang dikasih sama ChatGPT itu sudah benar atau belum bagaimana?	
SST2122	Dihitung ulang	V1
PST2123	Jadi tadi kamu sempat dikasih jawaban sama ChatGPT, terus dihitung ulang. Sama seperti cara yang kedua ya, karena tadi cuma disuruh memilih angka random tapi ternyata salah, akhirnya menyuruh untuk cari cara lain. Kalau misalnya ternyata jawaban yang dikasih sama ChatGPT dari cara lainnya itu masih salah, kamu mau bagaimana? Mau coba instruksi lain atau bagaimana?	
SST2124	Coba instruksi lain lagi. Mungkin instruksi lainnya agak lebih detail prompt-nya, biar nanti ChatGPT-nya juga paham apa yang dicari	V1
PST2129	Barisannya pun tidak mau diubah?	
SST2130	Oh, kalau barisannya mungkin angkanya diubah sedikit	V2.1

PST2131	Ubah mandiri atau mau arahin ChatGPT-nya biar ubah barisannya?	
SST2132	Ubah mandiri	V2.1

Based on the written responses of the MSE student in Figure 4 and the interview excerpt from PST 2 above, information regarding the student's creative thinking process was obtained as follows, in the preparation stage, the MSE student engaged in problem formulation only after receiving AI assistance. Initially facing a complete lack of strategic foresight upon reading the prompt, the student immediately deferred to ChatGPT by submitting a photo of the problem with a simple, contextless command, "jawab" (SST2108, SST2110). While the student's written response (P1) successfully demonstrated basic conceptual understanding by outlining the general arithmetic sequence formula and substituting the given constraints into a mathematical model, this framework was not built autonomously. Consequently, the preparation stage relied heavily on ChatGPT as a cognitive scaffold to kickstart the student's problem comprehension.

In the mini-incubation stage, the MSE student demonstrated active idea filtering and cognitive evaluation rather than passive reception. Driven by initial skepticism, the student openly disagreed with one of ChatGPT's initial methods because its outcome seemed incorrect, leading them to explicitly prompt the AI for alternative pathways (SST2112, SST2114). By systematically comparing the AI's varied responses against their own baseline knowledge, the student resolved cognitive conflicts until a coherent understanding was achieved (SST2118). Within this phase, ChatGPT functioned as a dynamic generator of strategic alternatives, while the student maintained administrative control over the selection process.

In the illumination stage, the MSE student achieved conceptual clarity primarily through the internalization of the AI's provided logic. The student seamlessly mastered and followed the systematic procedures generated by ChatGPT without experiencing any cognitive friction (SST2116). However, this insight remained strictly receptive, as the student directly adopted the AI's methodology without independently modifying the strategy or creating novel alternatives (SST2120). This structured implementation is verified by the written responses (IL2), which show a highly systematic execution and successful generation of compliant sequence variations derived entirely from the AI's blueprint.

In the verification stage, the MSE student maintained analytical rigor by manually recalculating ChatGPT's outputs to guarantee absolute correctness (SST2122). Demonstrating an evaluative mindset, the student established a clear contingency plan to deploy more detailed, iterative prompting if any discrepancies were detected (SST2124). Furthermore, the student tested the structural validity of the solution by executing limited, self-directed modifications, independently changing the specific values of the sequence to fit different scenarios (SST2130, SST2132). Ultimately, the verification stage was fully realized through active recalculation, error monitoring, and purposeful customization, though the student remained disinclined to explore entirely new strategies once the initial solution was verified.

Creative Thinking Processes of Students with Low Self-Efficacy (LSE) in ChatGPT-Assisted Mathematical Problem-Solving

The creative thinking process of the LSE student in ChatGPT-assisted mathematical problem-solving was identified through the written responses to the PST and the subsequent interview results. The following presents the written response of the LSE student to PST 1..

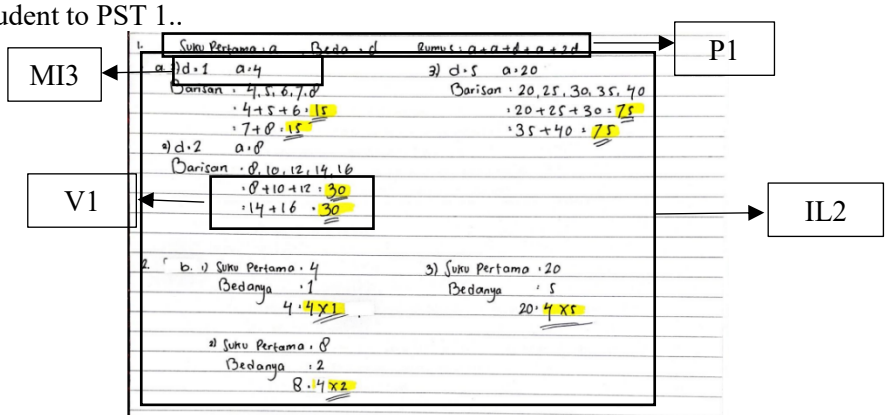


Figure 5. Subject LSE's Response to the PST 1

The following presents the interview excerpt of the MSE student regarding PST 1.

Label	Transkip Wawancara	Kode
PRT1135	Berarti setelah baca soalnya, langsung dimasukkan ke ChatGPT?	
SRT1136	Iya, soalnya aku juga agak lupa materi ini, jadi langsung aku masukkan ke ChatGPT	P1
PRT1137	Terus pas mau menggunakan ChatGPT, prompt yang kamu gunakan bagaimana? Apakah langsung foto soalnya atau bagaimana?	
SRT1138	Sebelum itu, aku masuk ke Google Lens dulu, terus aku salin teks soalnya. Baru setelah disalin, aku tempel di ChatGPT. Terus aku menulis instruksinya: "Tolong kerjakan soal ini."	P2
PRT1139	Pada saat ChatGPT memberikan jawaban, kamu langsung setuju atau ragu dan mencoba membandingkan sama pelajaran sebelumnya?	
SRT1140	Iya, agak ragu jadi coba ngebandingin sama referensi lain	IN1
PRT1143	Terus cara kamu agar bisa memahami jawaban ChatGPT itu bagaimana?	
SRT1144	Aku minta penjelasan lagi, seperti: "Coba jelaskan yang lebih rinci lagi."	IN1
PRT1147	Ada tidak penjelasan dari ChatGPT yang akhirnya membuat kamu merasa, "Oh, ternyata buat menjawab soal yang seperti ini caranya cukup pakai cara yang ini," atau bagaimana? Ada pikiran seperti itu?	
SRT1148	Iya, ada	IL1
PRT1149	Terus pas melihat jawaban dari ChatGPT, muncul ide tidak untuk menjawab pakai cara lain? Ingin dimodifikasi jawabannya, atau sudah pakai dari ChatGPT saja?	
SRT1150	Langsung dari ChatGPT saja	IL2
PRT1151	Tidak terpikir untuk mencari cara yang lain?	
SRT1152	Terpikir sih, soalnya aku ingin tahu cara yang lebih beda agar tidak itu-itu saja. Sempat terpikirkan, tapi kalau aku lihat dari jawabannya, aku rasa cara ini lebih gampang. Ternyata pas lihat cara yang lain itu agak rumit dan pusing, jadi pilih yang lebih gampang buat dipahami saja	IL2
PRT1157	Kamu kan sempat ragu nih sama jawaban ChatGPT. Sampai akhirnya yakin untuk memilih jawaban itu, apakah sempat menghitung sendiri?	
SRT1158	Iya, menghitung sendiri. Tapi yang aku hitung sendiri Cuma barisan ketiga saja. Soalnya rasanya agak mengganjal, terus akhirnya aku coba sendiri. "Oh, berarti begini caranya."	V1
PRT1159	Oke, berarti setelah dicoba hitung sendiri akhirnya dapat jawabannya dan yakin kalau	

	jawaban ChatGPT sudah benar ya. Kalau misalnya ChatGPT yang kamu gunakan memberikan jawaban yang sama ke teman-teman yang lain, apa yang akan kamu lakukan agar jawabannya terlihat berbeda?	
SRT1160	Cari referensi lain, biar beda sama temen-temen	V2

Based on the written responses of the LSE student in Figure 5 and the interview excerpt from PST 1 above, information regarding the student's creative thinking process was obtained as follows, in the preparation stage, the LSE student demonstrated problem formulation activities that were heavily dependent on AI intervention. Facing an immediate lack of strategic foresight upon reading the prompt, the student used Google Lens to extract the text and deployed a simple, direct command, "Tolong kerjakan soal ini" (SRT1134, SRT1136, SRT1138). While the written responses (P1) successfully outlined the general arithmetic sequence formula and generated compliant variations, this conceptual understanding was only established post-AI assistance. Consequently, the preparation stage was achieved, though ChatGPT served as the primary and vital cognitive scaffold to build the student's initial comprehension.

In the mini-incubation stage, the LSE student engaged in intentional strategy selection and internal evaluation rather than completely passive reception. Triggered by initial skepticism regarding ChatGPT's accuracy, the student cross-checked the output with external reference materials and explicitly asked for elaboration via the prompt, "Coba jelaskan lebih rinci lagi" (SRT1140, SRT1142, SRT1144). Although the student briefly considered alternative pathways, they ultimately selected the AI's method because it was deemed the most accessible and least complex (SRT1150, SRT1152). This deliberative filtering is evident in the written responses (IN3), which show a highly structured, sequential execution of the chosen AI method.

In the illumination stage, the LSE student experienced a baseline level of insight but displayed limited autonomous creativity. Interview data shows that the student achieved conceptual clarity regarding the problem's resolution directly from the AI's step-by-step breakdown (SRT1148). However, this phase was only partially realized in terms of independent creative thinking; the student explicitly admitted to using the AI's framework verbatim without introducing any modifications or novel variations (SRT1150, SRT1152). This is supported by the written responses (IL2), where the student strictly replicated the exact operational patterns established by ChatGPT.

In the verification stage, the LSE student executed analytical checking, though the overall validation process remained incomplete due to an underlying dependence on the AI. Driven by lingering uncertainty, the student manually recalculated specific portions of the solution to confirm computational accuracy (SRT1154, SRT1158). The student also expressed a willingness to consult external references to address persistent errors or to differentiate their answers from peers (SRT1156, SRT1160). However, the student conceded that they would blindly transfer this strategy to similar problems without further mathematical proof due to an absolute trust in the AI's systemic accuracy (SRT1162). Thus, the verification stage was only partially fulfilled, striking a balance between manual verification and a strong reliance on ChatGPT.

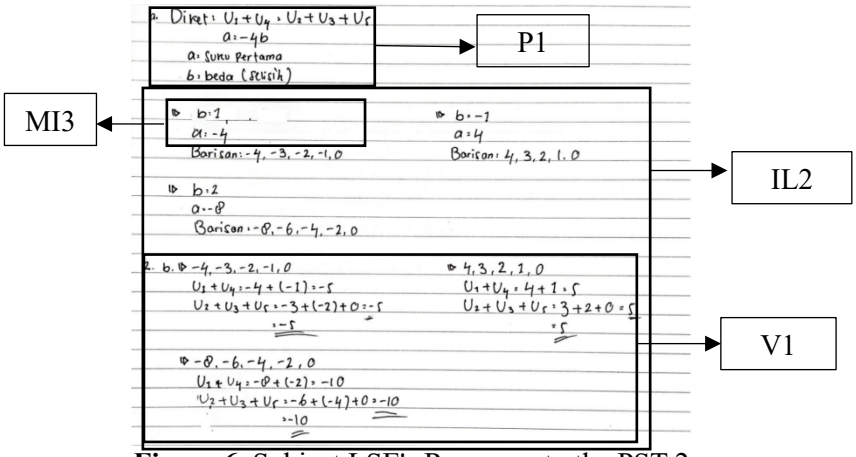


Figure 6. Subject LSE's Response to the PST 2

The following presents the interview excerpt of the LSE student regarding PST 2.

Label	Transkip Wawancara	Kode
PRT2163	Pas melihat soalnya ini, kamu kepikiran gimana? Langsung ke ChatGPT-kah atau gimana?	
SRT2164	Langsung ke ChatGPT saja	P1
PRT2165	Oke, langsung ke ChatGPT saja. Sempat kepikiran gimana cara menyelesaikan soal ini tidak?	
SRT2166	Ada sih, Kak. Waktu aku ingin mengerjakan, aslinya ingin mengerjakan tanpa ChatGPT, Cuma sudah lupa gitu loh, sudah lupa caranya gimana gitu. Jadi kayaknya aku langsung saja ke ChatGPT biar nanti teringat lagi gimana cara kerjanya	P1
PRT2167	Prompt yang kamu kasih ke ChatGPT-nya gimana?	
SRT2168	Aku tadi kayak langsung salin, terus aku menyuruh kerjakan saja. Cuma tadi itu kayak agak tidak jelas gitu, jadi aku kayak lebih rinci lagi, lebih rinci lagi	P2
PRT2171	Jawaban dari ChatGPT sempat ada yang kamu tidak setuju, atau langsung setuju aja?	
SRT2172	Iya ada, jadi aku coba lagi sama cari referensi lain	IN1
PRT2173	Ada jawaban yang kurang dipahami tidak tadi dari ChatGPT-nya?	
SRT2174	Ada, Cuma yang bagian B saja sih. Soalnya cara lainnya kayak agak gimana gitu, agak kurang jelas ya.	IN1
PRT2175	Itu gimana caranya akhirnya kamu buat memahami bagian B?	
SRT2176	Aku cari referensi lain	IN1
PRT2177	Sempat mencoba beberapa prompt berarti akhirnya biar sreg sama jawaban ChatGPT?	
SRT2178	Iya	IN2
PRT2179	Ada bagian dari ChatGPT yang menjelaskan tidak akhirnya kayak, “Oh, aku ternyata bisa pakai cara yang ini di bagian B,” atau…?	
SRT2180	Iya ada	IL1
PRT2183	Oke, jadi kayak sudah mengikuti jawaban yang dikasih saja. Kalau barisannya dimodifikasi atau tidak?	
SRT2184	Tidak. Langsung dari jawaban ChatGPT	IL2
PRT2185	Pas mengerjakan ini, gimana akhirnya kamu yakin kalau misalnya langkah-langkah yang dikasih sama ChatGPT itu sudah benar?	
SRT2186	Soalnya aku sudah coba kayak menghitung sendiri. Oh, kayaknya ini sudah benar deh, gitu.	V1
PRT2187	Berarti buat kamu supaya yakin kalau misalnya jawabannya sudah benar, dihitung ulang. Tapi barisannya langsung tetap	

	mengambil yang dari ChatGPT, tidak dimodifikasi ulang. Oke. Kalau misalnya jawaban dari ChatGPT yang dikasih ke kamu ini sama kayak teman-temannya yang lain, kamu mau gimana?	
SRT2188	Ingin diubah sedikit saja biar beda dari yang lain.	V2

Based on the written responses of the LSE student in Figure 6 and the interview excerpt from PST 1 above, information regarding the student's creative thinking process was obtained as follows, in the preparation stage, the LSE student possessed a vague initial schema but heavily relied on ChatGPT to compensate for cognitive retrieval difficulties. Although the student initially intended to solve the task independently, an inability to recall the exact procedures prompted immediate recourse to the AI as a memory-jogging and reinforcement tool (SRT2164, SRT2166). The student demonstrated information-gathering behavior by entering the basic command "Kerjakan" and subsequently demanding more elaboration via the prompt "Lebih rinci lagi" when clarity was lacking (SRT2168, SRT2170). While the written responses (P1) successfully organized the data parameters and structured compliant arithmetic sequence variations, this comprehensive understanding was fully unlocked only after leveraging the AI's scaffolding.

In the mini-incubation stage, the LSE student engaged in active strategic filtering and comparative evaluation. Rather than blindly adopting the AI's output, the student openly challenged ChatGPT's initial solution, testing multiple prompts and consulting external reference materials to cross-check and reconcile conflicting data (SRT2172, SRT2176, SRT2178). Within this phase, ChatGPT acted as a fluid repository of raw solutions that the student meticulously screened before final adoption. This intentional evaluation process is corroborated by the written responses (IN3), which display a systematic and highly organized execution of the meticulously chosen strategy.

In the illumination stage, the LSE student achieved conceptual insight regarding the mathematical logic but failed to extend it into autonomous creative production. Interview data reveals that the student experienced a clear moment of understanding, decoding specific problem-solving pathways directly from the AI's instructional explanations (SRT2180). However, this stage was only partially fulfilled regarding creative thinking; the student explicitly admitted to copying the AI's output verbatim without attempting any personal modifications or structural variations (SRT2184). This absolute duplication is mirrored in the written responses (IL2), which strictly adhere to the AI's operational blueprint without any independent conceptual expansion.

In the verification stage, the LSE student demonstrated analytical monitoring by manually verifying the mathematical validity of the AI-generated solutions. The student independently recalculated the solution steps and verified the final sums of the sequence terms in their written work to ensure total precision (SRT2186). Furthermore, the student showed adaptive awareness by planning to slightly modify the sequence structures to ensure originality if their classmates utilized identical methods (SRT2188), and expressed confidence in the strategic transferability of this template to similar problem types (SRT2190). Consequently, the verification stage was successfully achieved through active computational checks, deliberate solution tailoring, and schema consolidation.

Table 5 summarizes the similarities and differences in creative thinking processes among HSE, MSE, and LSE students during ChatGPT-assisted mathematical problem-solving.

Table 5. Similarities and Differences in Creative Thinking Processes Among HSE, MSE, and LSE Students

Stages of the Creative Thinking Process	Indicator	HSE Student	MSE Student	LSE Student
Preparation (P)	Defining and formulating the problems (P1)	The HSE, MSE, and LSE students demonstrated problem formulation by constructing mathematical models based on the prompts; however, all three groups exhibited varying levels of independence when utilizing ChatGPT.		
	Collecting and associating relevant information (P2)	The HSE, MSE, and LSE students demonstrated information gathering and conceptual association with prior experiences; however, this process was heavily reinforced and confirmed through ChatGPT.		
Mini Incubation (MI)	Processing problem-solving ideas subconsciously (MI1)	The HSE, MSE, and LSE students demonstrated idea evaluation and selection based on the strategic information obtained from ChatGPT.		

Stages of the Creative Thinking Process	Indicator	HSE Student	MSE Student	LSE Student
	Selecting the most appropriate problem-solving strategy (MI2)	The HSE, MSE, and LSE students selected their preferred problem-solving strategies strictly from the alternative solutions provided by ChatGPT.		
	Structuring the execution plan based on the chosen strategy (MI3)	The HSE, MSE, and LSE students systematically constructed their execution steps based on the chosen strategy, yet all three groups strictly replicated the baseline pattern provided by ChatGPT.		
Illumination (IL)	Generating new insights or innovative problem-solving ideas (IL1)	The HSE student began to exhibit novel mathematical insights, although these generations remained limited.	The MSE student failed to generate novel insights, producing only minor strategic modifications.	The LSE student generated no novel insights, completely replicating the explanations provided by ChatGPT.
	Solving the problems systematically according to the pre-selected strategy (IL2)	The HSE, MSE, and LSE students executed their problem-solving processes strictly in accordance with their selected strategies.		
Verification (V)	Testing and verifying the obtained solutions or results (V1)	The HSE, MSE, and LSE students verified their final results through recalculation to ensure accuracy.		
	Cross-checking the results utilizing alternative problem-solving methods (V2)	The HSE student employed alternative numerical variations to verify the mathematical validity of the solution.	The MSE student evaluated the transferability of the strategy to alternative problems and corrected errors, although these adjustments remained limited.	The LSE student performed only a rudimentary verification, strictly limited to the final numerical calculation.

Table 5 indicates that all subjects progressed through the stages of preparation, mini-incubation, illumination, and verification during ChatGPT-assisted mathematical problem-solving. Nonetheless, distinct variations emerged regarding their independence in strategy formulation, capacity for generating novel insights, and depth of verification. A comprehensive delineation of these creative thinking characteristics across each self-efficacy category is presented in the subsequent sections.

CONCLUSION

Three students carried out four core stages of creative thinking—preparation, mini-incubation, illumination, and verification—their cognitive independence and depth of processing varied distinctively based on their self-efficacy levels. The high self-efficacy student exhibited the highest level of cognitive autonomy, utilizing ChatGPT merely as a cognitive sounding board; they demonstrated strong execution in the preparation stage and conducted rigorous verification by employing alternative numerical variations. In contrast, the medium self-efficacy student engaged actively during preparation and mini-incubation but displayed partial dependency on AI, resulting in minor strategic modifications during illumination and only localized, simple verifications. Meanwhile, the low self-efficacy student operated under heavy external cognitive dependency, directly replicating ChatGPT's pathways across all stages with minimal autonomy in problem formulation, zero strategic modification, and only rudimentary verification. Ultimately, these profiles indicate that higher mathematical self-efficacy correlates with greater cognitive autonomy and rigorous validation when utilizing AI tools, whereas lower self-efficacy shifts the AI's role from a learning scaffolding tool to an external cognitive substitute.

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