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Exploration of junior high school students perseverance in mathematical reasoning on data presentation material

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Abstract

This qualitative study explores Perseverance in Mathematical Reasoning (PiMR) in a junior high school student while solving a Data Presentation problem. A qualitative approach was chosen to gain an in-depth and contextual understanding of the subject's reasoning process and behaviors. The background for this study is the low level of mathematical reasoning perseverance among Indonesian students, which is a crucial ability. This study used a PISA-model written test and an interview with one seventh-grade subject. Data were analyzed using the Miles and Huberman model through data reduction, data display, and conclusion drawing. In general, the subject successfully demonstrated some indicators of PiMR, such as exploring solutions and attempting to correct answers. However, the main finding reveals the subject's inability to adjust strategies when facing an impasse, which resulted in the final answer remaining incorrect. The implication of this research emphasizes the need for targeted educational support to develop mathematical reasoning perseverance in students that is not only persistent but also more adaptive and sustainable.

Keywords: Data Presentation, Perseverance in Mathematical Reasoning

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INTRODUCTION

Mathematical reasoning ability is a crucial foundation in learning mathematics. One of the abilities that students must possess in learning mathematics is mathematical reasoning ability (Asdarina & Ridha, 2020). This ability not only serves as the basis for acquiring and constructing mathematical knowledge (Wirawan et al., 2023). This is because reasoning supports analytical skills, as explained by Rohati et al. (2022) that the reasoning process typically begins with identifying components and objectives, such as problems presented in the context of mathematics learning, followed by the natural emergence of initial responses, and finally through the application of analytical processing techniques. According Romsih et al. (2019) mathematics is understood through reasoning, and vice versa. Therefore, mathematical reasoning ability must always be cultivated in every mathematics learning session.

On the other hand, to master this challenging reasoning ability, students require perseverance. Perseverance is defined as an attitude of being earnest, enthusiastic, and persistent in facing problems (Opinsi & Kurniah, 2022). It is a primary factor influencing the improvement of mathematics learning outcomes (Rasyid et al., 2025). The mathematics learning process indeed demands self-capability, thinking skills, and extra perseverance to produce high-quality learning (Taufik & Komar, 2021).

The relationship between perseverance and mathematical reasoning is inseparable. This aligns with the idea that perseverance and mathematical reasoning are interrelated, as explained by Santana et al., (2022) that mathematical material is understood through reasoning, and reasoning is understood through frequent practice and studying mathematical material. According to Chusna et al.,(2019) students' reasoning abilities can be honed if students have a positive attitude, are diligent, and are persistent in facing mathematical difficulties. High perseverance helps students overcome the cognitive and affective difficulties that arise when they engage in the process of mathematical reasoning (Barnes, 2019). According to Rasyid et al., (2025) in the context of Perseverance in Mathematical Reasoning (PiMR), these two aspects are interrelated. The concept of PiMR is defined as a persistent effort to engage in a series of mathematical reasoning, despite facing difficulties or delays in achieving success (Barnes, 2021).

However, in reality, the mathematical reasoning ability of Indonesian students is still low (Sabri & Salim, 2024). This aligns with Muhsana & Diana, (2022) who state that, in fact, many students in Indonesia still find it difficult to solve problems that require reasoning skills. Based on an interview conducted by the researcher with a mathematics teacher at Adhyaksa 1 Junior High School in Jambi, it was stated that students' perseverance in mathematical reasoning is still relatively low. This is known from the teacher's observations during the learning process, where students tend to give up and stop easily when faced with mathematical problems. This low level of effort in facing challenges indicates that the indicators of PiMR in the Striving aspect have not been achieved, specifically the indicator that they are less able to persist in solving problems requiring in-depth analysis. In other words, when faced with complex mathematical challenges, students often lose motivation and do not attempt to find solutions, thus illustrating their weak perseverance in mathematical reasoning.

The selection of the data presentation topic is related to the material taught in Junior High School. This aligns with Muhaajir et al. (2024) who state that data presentation and diagrams are one of the topics taught in seventh-grade mathematics in the second semester. In accordance

with the curriculum, the discussion of data and diagrams is presented at every educational level (Irawan et al. 2025). When learning this topic, students are expected to be able to organize data and diagrams appropriately to facilitate the process of reading, understanding, and analyzing the presented information (Ramadanti et al., 2021). It is this ability that we aim to investigate further how students use their reasoning to understand, process, and represent data, as well as the challenges they face during this process. Therefore, the topic of data presentation provides a suitable context for observing students' perseverance in reasoning within an applicable context.

Typically, research on mathematical reasoning and perseverance is conducted separately. In the context of Perseverance in Mathematical Reasoning (PiMR), these two aspects are interrelated (Rasyid et al., 2025). Several related studies, such as those conducted by Barnes, (2019), Barnes, (2021) and Rasyid et al., (2025) demonstrate the importance of PiMR. Nevertheless, research that examines Junior High School students' Perseverance in Mathematical Reasoning specifically on the topic of Data Presentation has not been found. Based on this identified research gap, this study was designed with the research question: "How is the exploration of Junior High School students' PiMR in solving mathematical problems on the topic of Data Presentation?". In line with this, the objective of this research is to explore Junior High School students' PiMR in solving mathematical problems on the topic of Data Presentation.

METHOD

This study is descriptive research that employs a qualitative approach aimed at exploring students' Perseverance in Mathematical Reasoning (PiMR) when solving mathematics problems on the topic of Data Presentation. The research was conducted at SMP Adhyaksa 1 Jambi during the even semester of the 2025/2026 academic year, involving a seventh-grade class. The reason for selecting SMP Adhyaksa 1 Jambi was based on observational results indicating low perseverance in students' mathematical reasoning. The primary data sources for this study were the research subject and the researcher. The research subject was one seventh-grade student from SMP Adhyaksa 1 Jambi, selected through purposive sampling. Secondary data sources included the student's written answer sheets from the Data Presentation test, and finally, interviews related to the student's perseverance during the written test. The analysis technique used in this study was the Miles and Huberman model analysis technique, where qualitative data analysis activities are conducted actively until data saturation is achieved. First,

data reduction was performed by coding all data (test results and interviews) based on the established PiMR indicators. Data unrelated to the PiMR indicators were filtered out. Second, data presentation was carried out by organizing the coded data into matrices or narratives describing the manifestation of each PiMR indicator in the subject. Third, conclusion drawing was performed by interpreting the patterns that emerged from the matrices to answer the research question regarding the exploration of the subject's PiMR. To ensure data validity, triangulation was conducted by comparing data from the written test results, in-depth interviews, and documentation (such as students' scratch work).

RESULTS AND DISCUSSION

As part of the selection process, a written test was administered to all seventh-grade students of SMP Adhyaksa 1 Jambi to map their PiMR tendencies. From this population, one student was then selected as the research subject using a purposive sampling technique for in-depth exploration. The exploration of this selected subject was guided by the following PiMR indicators:

Stiriving

Exploring Various Possible Solutions

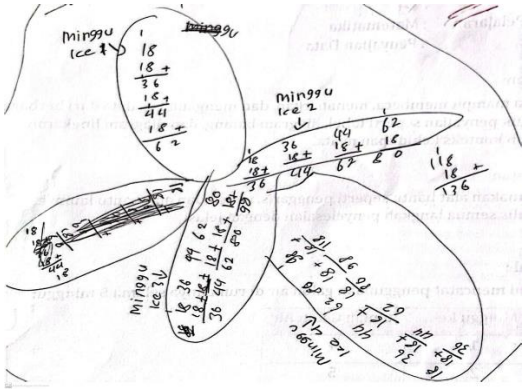

Figure 1. PA Scribbles Exploring Answers

During the problem-solving process, PA appeared active in trying out various possible solutions to arrive at an answer. This can be seen in Figure 1, which shows several alternative scribbles they made to determine the average gallon usage per week, where each circle in the figure represents one week.

Effort in Facing Challenges

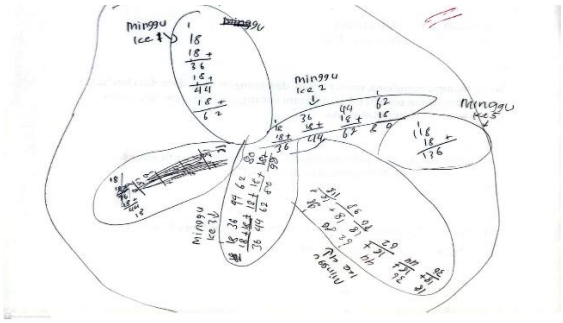

Figure 2. PA Answer Results

PA met this indicator, as they were able to continue working on the problem until obtaining a final answer, despite encountering obstacles, as can be seen in Figure 2. In the figure, where each circle represents one week, PA demonstrated resilience by persistently continuing the problem-solving process independently without requesting external assistance.

Seeking Evidence to Support His Answer

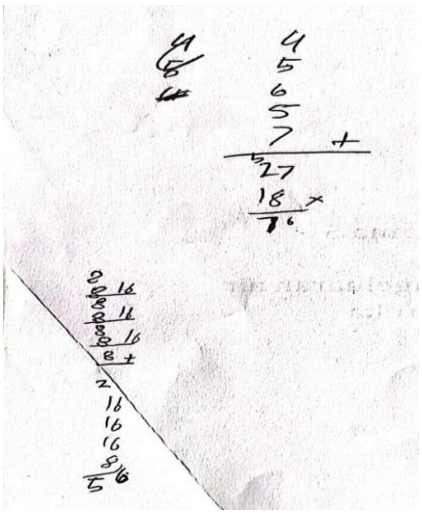

Figure 3 PA Scribbles Seeking Answer Evidence

PA was seen recalculating their answer as an effort to verify that the answer obtained was correct.

Correcting Mistakes

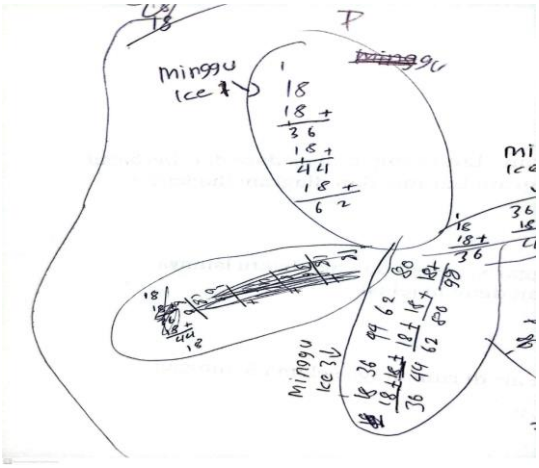

Figure 4 shows PA's Answer Correction

From Figure 4, it can be seen that PA attempted to correct his error. Although after his efforts the answer he obtained was still incorrect, this behavior conceptually reflects the *striving* aspect of PiMR, which emphasizes the value of the process and resilience, not just the final outcome (Barnes, 2019). Even though the correction did not yield the correct answer, the initiative to fix the mistake demonstrates the development of a *conative focus*—that is, the willingness to engage actively with the problem.

Self-Regulatory Processes

Reflection on Previous Attempts

For this indicator, PA also demonstrated evaluative behavior towards the steps they had taken during the problem-solving process. PA appeared to pause briefly to assess the results of their work after finding an error, then corrected the steps used. Although the final answer was still not correct, PA reassessed their work and tried to fix the steps they felt were mistaken.

Strategy Adjustment or Correction

The subject, PA, did not show any effort to adjust their strategy. PA tended to persist with the initial method even though it did not yield the correct result.

Emotional Monitoring and Feeling Control

PA met this indicator. Although they briefly showed signs of frustration or emotional pressure when facing difficulties in solving the problem, PA was still able to continue their work until completion. This was evident from their facial expressions and body language, which showed momentary tension but did not stop the problem-solving process.

Active Goals

Focus on Understanding

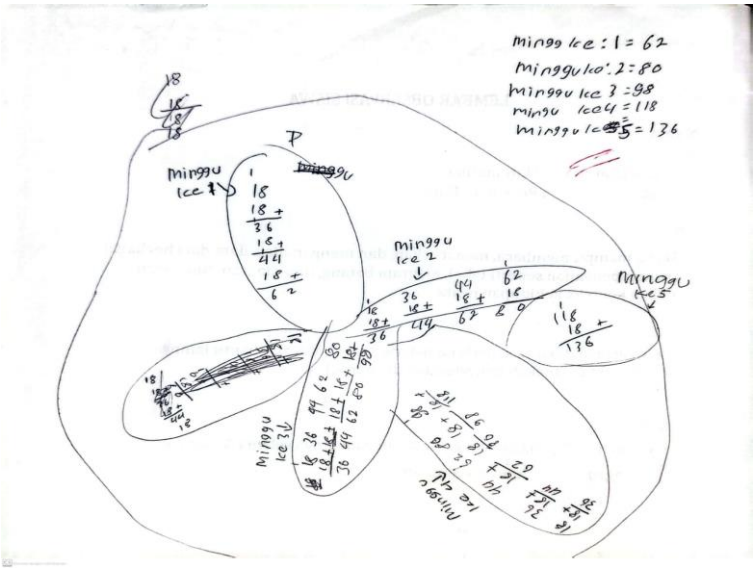

Figure 4 PA Answer

As seen in Figure 5, PA appeared to lack a clear understanding of the problem's intent, evident from how they concluded and reformulated the problem, where each circle in the figure represents one week. This misunderstanding of the concept ultimately led to errors in the solution.

Focus on Conducting Successful Trials

As shown in Figure 3, PA attempted to support their answer through trials, but these trials were unsuccessful. Based on the interview, PA explained that they were aware of errors in their calculation process while seeking supporting evidence but made no further effort to determine the correct average value. This indicates that PA did not focus on conducting successful trials.

Setting the Final Goal

PA demonstrated focus and consistency in solving the problem according to the established final goal. This was evident from their problem-solving process, which remained undistracted by irrelevant matters. In their final answer, PA successfully completed the problem as required, focusing on seeking alternative solutions, as shown in Figure 2.

The overall research findings illustrate that PA demonstrated a level of mathematical reasoning perseverance that is not yet mature. Although he consistently met several indicators of the striving aspect such as the willingness to explore various solutions, persist in facing challenges, and take the initiative to correct errors this perseverance was not supported by

adequate self-regulation ability. A critical limitation was observed in his inability to adjust strategies when facing an impasse, where PA persisted with the initial method even though it had proven ineffective. This pattern indicates that PA's perseverance was still characterized as habitual persistence (Williams, 2014). which continues without strategic consideration, rather than the adaptive perseverance that marks effective PiMR. This configuration explains why, despite showing diligent effort, PA did not succeed in reaching a correct solution. This finding underscores that effective mathematical perseverance requires a balance between striving and self-regulation ability, enabling strategic flexibility when confronting challenges.

These findings indicate that PA demonstrated an effort to correct his errors, although not entirely successfully. As shown in Figure 4, PA revised his answer after recognizing inaccuracies in his initial result. This effort reveals reflective awareness of errors and an intention to improve manifesting striving, which is part of the conative component of Perseverance in Mathematical Reasoning (PiMR) (Barnes, 2019). However, based on his final work, PA's answer remained incorrect after the revision, indicating that he was unsuccessful in completely rectifying the error. Thus, the indicator of "correcting errors" was not fully met, as it only extended to showing initiative and effort to correct, without achieving a valid solution. This suggests limitations in his cognitive self-regulation ability (Özcan, 2016) to effectively monitor and adjust his thinking process.

Additionally, the results show that PA engaged in reflection during the problem-solving process. This was evident not only from his behavior of pausing to evaluate previous steps but also from his follow-up actions, such as attempting to correct mistakes and seeking supporting evidence for his answers. This is reflected in PA's process of rechecking his calculations see Figure 4 after realizing potential errors and trying to reconfirm the validity of his solution see Figure 3. Although the final outcome remained incorrect, PA's reflective actions demonstrate that he did not passively accept failure but actively sought to understand and improve his thinking process. This indicates that PA is at an early stage of reflective ability aware of errors and attempting to find more accurate solutions, even though it has not yet yielded mathematically correct results. This effort represents a developing form of cognitive self-regulation (Goswami, 2015), where awareness has emerged, but effective follow-through remains hindered.

PA did not demonstrate any effort to adjust or refine his problem-solving strategy. Although PA encountered difficulties and obtained an incorrect answer, he persisted with the same approach from start to finish, without attempting alternative strategies or methods. In fact,

while attempting to find supporting evidence for his answer, PA had already recognized that parts of his solution were flawed. This awareness should have presented an opportunity for PA to modify or improve his approach. However, PA did not capitalize on this opportunity and continued solving the problem using the same strategy as before. This indicates that while PA demonstrated effort in completing the task, he lacked the flexibility to adapt his strategy when faced with obstacles. This behavior reflects limitations in self-regulation and a tendency toward habitual or mere persistent behavior, rather than genuine perseverance (Williams, 2014), where a student continues without evaluating the effectiveness of their attempts.

During the problem-solving process, PA displayed signs of frustration and panic when encountering difficulties, yet he managed to continue working until completion. This was evident from his momentary tense facial expressions and body language, as well as the fact that he temporarily paused working to calm himself. Based on the interview results, PA explained that his method of self-regulation was to slowly reread and comprehend the problem until he felt able to refocus, then resume solving it. This strategy reflects a foundational ability in emotional regulation a conscious effort to manage negative emotions to prevent them from interfering with cognitive processes and task completion.

PA's difficulty in understanding the problem's requirements, as shown in Figure 5, served as a critical initial cognitive barrier. According to Mason et al., (2010), theory, the specialising stage forms the foundation of reasoning. PA’s failure at this stage, marked by incorrect mathematical modeling, indicates that his perseverance was not supported by adequate conceptual understanding. In other words, the perseverance he demonstrated subsequently proceeded without proper direction from the outset.

Although PA actively engaged in experimentation as shown in Figure 3, the resulting pattern was an unproductive repetitive cycle. Theory helps interpret this behavior as a form of repetitive specialising the student became trapped in repeating similar trials without making the leap toward generalization or strategy evaluation. PA's awareness of his errors was not followed by metacognitive actions to change his approach. Here, his cognitive perseverance was illusory: while he persisted diligently, his efforts lacked deep consideration about the value of each attempt.

From Figure 2, it is evident that PA successfully established an ultimate goal for the problem-solving process. PA demonstrated focus and consistency in working toward this predetermined goal, reflected in his undistracted progression without deviation to irrelevant external factors. He maintained focus on finding a solution until eventually completing the

problem. In this regard, PA successfully set an active goal and directed all his efforts toward achieving it, even though the final answer remained incorrect. However, PA's active goal appeared limited to producing a solution and did not evolve into more substantive objectives such as explaining why the generalization was valid a characteristic of successful PiMR (Barnes, 2021).

PA's emotional dynamics, such as the frustration he attempted to regulate in Figure 4, cannot be separated from the quality of his reasoning. His ability to calm himself and refocus demonstrates conative focus (Barnes, 2019), the capacity to consciously direct mental effort despite negative emotions. This emotional aspect enabled his cognitive perseverance to continue, even though it ultimately proved ineffective. Thus, the emotional dimension functioned as an enabler for cognitive persistence, though it did not guarantee effectiveness..

Overall, PA's PiMR profile depicts a student with motivation and striving, capable of managing emotions to persist, and possessing clear goals. However, he lacks the crucial component of successful PiMR cognitive self-regulation that enables strategic flexibility (Özcan, 2016). His perseverance is linear and rigid rather than adaptive and reflective. This configuration explains the paradox in the findings a behaviorally persistent student ultimately failed to solve the problem because his perseverance was not equipped with the metacognitive skills to evaluate and adjust strategies.

CONCLUSION

This study aims to explore the Perseverance in Mathematical Reasoning (PiMR) demonstrated by junior high school students in solving Data Presentation problems. The results indicate that students are capable of showing effort in addressing mathematical challenges, such as attempting various possible solutions and demonstrating a willingness to correct errors. However, the efforts displayed remain limited. Students tend to stay within their comfort zones and have not yet shown strategic flexibility or the ability to fully resolve problems. This suggests that although there is a drive to complete tasks, students' persistence is not yet strong enough to fully overcome difficulties within the context of PiMR.

Theoretically, these findings enrich the Perseverance in Mathematical Reasoning (PiMR) framework by clarifying the complexity of the construct through empirical evidence. This study confirms that mathematical perseverance is not merely persistent effort but rather a dynamic interaction among striving, self-regulatory processes, and active goals. Furthermore, the discovery of students exhibiting high perseverance while being hindered by strategic rigidity

makes an important contribution by operationally distinguishing between unproductive habitual persistence and the adaptive perseverance that characterizes effective PiMR.

Based on these findings, educators can optimize students' PiMR through targeted interventions. To address weaknesses in cognitive self-regulation, teachers can systematically integrate metacognitive guiding questions that encourage students to reflect on their strategies. Establishing cycles of formative feedback focused on thinking processes will help students identify impasses and evaluate strategy effectiveness. Additionally, implementing authentic problem-based learning creates natural contexts for students to develop strategic flexibility and build adaptive perseverance. The limitation of this study regarding its narrow subject scope opens opportunities for further research with more diverse samples to explore the influence of other factors such as mathematical beliefs and environmental support on the development of PiMR.

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