



# Self-Regulated Learning for Vocational Students' Inductive Thinking in Solving Contextual Geometric-Sequence Problems

Ragista Maya Sari, Adi Nurcahyo\*, Annisa Swastika

Department of Mathematics Education, Universitas Muhammadiyah Surakarta, Surakarta, Indonesia

\*Corresponding author's email: [an123@ums.ac.id](mailto:an123@ums.ac.id)

---

## Submission

### Track:

Received:

25 December 2025

Final Revision:

30 January 2026

Available online:

15 February 2026

## ABSTRACT

Contextual problems play an important role in learning in vocational high schools because they connect mathematical concepts with real-life situations relevant to students. However, studies that specifically examine vocational high school students' inductive thinking skills in solving contextual mathematical problems, particularly in geometric sequences, viewed from the level of Self-Regulated Learning (SRL), are still limited. This study aims to analyze the inductive thinking abilities of vocational high school students in solving contextual geometric sequence problems based on their SRL levels. A qualitative approach with descriptive analysis was employed. The research subjects consisted of 33 eleventh-grade students from the Accounting and Institutional Finance class at SMK Negeri 1 Boyolali. The results showed that 3 students were categorized as having high SRL, 24 students had moderate SRL, and 6 students had low SRL. Analysis of students' responses revealed that students with high SRL were able to meet all indicators of inductive reasoning, namely observing regularities, identifying patterns, and formulating generalizations. Students with moderate SRL were able to observe regularities and identify patterns but experienced difficulties in formulating generalizations. Meanwhile, students with low SRL were only able to observe regularities. These findings indicate that SRL levels influence students' inductive thinking abilities. This research revealing students' characteristics and difficulties at each inductive reasoning indicator based on SRL levels within the context of geometric sequences in vocational high schools, as well as providing practical implications for teachers in designing more effective contextual mathematics learning.

**Keywords:** Geometric Sequences, Inductive Reasoning, Problem Solving, Self-Regulated Learning

---

DOI: 10.23917/varidika.v38i2.15096

## INTRODUCTION

Mathematics is one of the subjects taught at all levels of education and plays an important role in the advancement of science and technology (Putri et al., 2022). Mathematics is also seen as a universal language that trains logical, analytical, and systematic thinking skills, thus forming the basis for the development of modern science and technology (OECD, 2019). As a discipline, mathematics is often applied in daily activities, so that solving various real-life problems requires mathematical problem-solving skills. Therefore, students are expected to be able to develop good problem-solving skills, considering that many students still have difficulty applying mathematical knowledge in real-life

situations (Anugraheni, [2019](#)). Mathematics education is expected to help students understand mathematical concepts that can be applied in various fields of science and in everyday life (Fathan, [2025](#)). In the mathematics learning process, there are various skills that can be developed, one of which is the ability to understand concepts. Conceptual understanding is a very important component in mathematics learning because it supports students' ability to reason, connect ideas, and solve mathematical problems effectively (Wibowo et al., [2024](#)). However, in practice, this educational goal has not been fully achieved. This is reflected in students' limited ability to understand, reason, and apply mathematical concepts.

According to a survey conducted by the Organization for Economic Cooperation and Development (OECD) through the Programme for International Student Assessment (PISA) in its latest report, the average mathematics literacy score of Indonesian students is 366, which is much lower than the OECD average of 472. In addition, only about 18% of Indonesian students are able to reach level 2 in mathematical understanding, a figure that lags far behind the OECD average of 69% (OECD, [2023](#)). Mathematical literacy reflects an individual's ability to formulate, apply, and interpret mathematics in various contexts (OECD, [2019](#)). Research by Medyasari et al. ([2020](#)) reports that the percentage of students' mathematical problem-solving skills only reaches 53.4%. This is reinforced by Prameswari & Abadi ([2025](#)) who show that students' problem-solving skills are still relatively low. Based on this data, it can be concluded that Indonesian students' mathematical problem-solving skills are still categorized as low.

In mathematics education, these skills are important to help students think critically and creatively. According to Polya ([2004](#)), problem solving is a complex cognitive process that involves the ability to understand problems, plan solution strategies, apply selected strategies, and evaluate the results obtained. According to Yuwono & Murniasih ([2024](#)), problem solving is the ability to use prior knowledge to understand and solve new problems. Nurcahyani & Sumardi ([2022](#)) emphasize the importance of developing these skills in school. Adeoye & Jimoh ([2023](#)) state that problem solving is an important competency in the 21st century to face real challenges.

Problem solving is a sequential thinking process that involves understanding problems, planning, implementing, and evaluating solutions to train students to think critically, creatively, and adaptively in facing real situations and in the learning process. Problem solving is important to develop in order to train inductive reasoning, critical thinking, and creativity. Problem-solving skills are important in mathematics learning because they help students apply the concepts they have learned in the context of problem-solving and real life (Siswanto & Meiliasari, [2024](#)). According to Nursoffina & Efendi ([2021](#)), problem-solving skills are related to mathematical reasoning because they are the basis for understanding and solving mathematical problems. Therefore, problem-solving skills in mathematics are interrelated with mathematical reasoning.

Mathematical reasoning is the ability to think systematically with the aim of reaching conclusions (Wardani & Amidi, [2025](#)). Mathematical reasoning skills play an important role in the mathematics learning process because they help students understand the material. Meanwhile, low reasoning hinders student understanding (Tukaryanto et al., [2018](#)). Reasoning skills also help students solve problems because they make it easier for them to understand and find solutions to the problems they face (Cahyani & Sritresna, [2023](#)). Therefore, reasoning skills are one of the keys to student success in learning and solving mathematical problems. According to Izzah & Azizah ([2019](#)), there are two types of reasoning, namely inductive reasoning and deductive reasoning. Inductive reasoning is a way of thinking to draw new conclusions based on general patterns from information that is considered true. Meanwhile, deductive reasoning is the process of obtaining the truth of a concept based on previously known truths. According to Polya ([2004](#)), inductive reasoning is the process of constructing general assumptions based on observations of specific examples. Mulyasari ([2018](#)) research shows that the inductive approach is more effective in improving students' reasoning skills. Angraini et al. ([2023](#)) state that inductive reasoning helps students form initial assumptions that are useful for investigation in mathematics learning. In addition, Van Vo & Csapó ([2020](#)) also found that inductive reasoning contributes significantly to students' academic success, especially in solving complex problems such as series and sequences. Therefore, strong inductive reasoning is an important prerequisite for students to understand concepts that require deeper understanding, one of which is geometric sequences.

A geometric sequence is a sequence of numbers in which each term is obtained from the previous term by multiplying it by a constant number (Kementrian Pendidikan dan Kebudayaan Republik Indonesia, [2017](#)). In vocational high schools, particularly in Phase E, learning about sequences and series, including geometric series, is taught to strengthen students' conceptual understanding (BSKAP, [2025](#)). However, in practice, many students still experience difficulties with this material. (Magfiroh et al., [2024](#)) found that vocational students had difficulty choosing the right solution strategy and identifying patterns in number sequences, especially in geometric sequences. Damayanti & Kartini (2022) also reported that students were unable to conclude the meaning of their answers, especially in contextual questions. Tasoin & Adibah ([2024](#)) highlighted the low ability of vocational high school students in solving contextual problems in geometric sequences and series, especially related to understanding the context, applying formulas, and drawing conclusions. These findings indicate that geometric sequence material is still a challenge for vocational high school students, especially in solving contextual problems.

There have been previous studies related to this research topic. Among them, a study by Astuti et al. ([2023](#)) examined contextual problem solving in 11th grade high school students in the subject of sequences and series. The results showed that although most students were able to understand the questions and determine the correct answers, many had difficulty in planning and implementing solution

strategies based on Pólya's steps. Wijayanti (2022) research examined the effectiveness of the contextual approach in improving students' inductive reasoning skills and showed that the contextual approach was effective in improving inductive reasoning. Research by Evidiasari & Irawati (2019) examined the inductive reasoning process in geometric transformation material. The results showed that high-ability students completed all steps of inductive reasoning correctly, medium-ability students still made mistakes in the generalization stage, and low-ability students only analyzed the initial data and were unable to prove anything. Research by Rahmatika & Waluya (2023) examined the effect of self-regulated learning on students' mathematical reasoning abilities in the Missouri Mathematics Project learning with an open-ended approach. The results showed that SRL had a 17.1% effect on mathematical reasoning abilities. However, there has not been much research examining inductive reasoning and self-regulated learning in the process of solving contextual mathematical problems in geometric sequences. In addition, the integration of self-regulated learning as a supporting factor for inductive reasoning and contextual problem solving has rarely been studied comprehensively.

Self-Regulated Learning (SRL) is the ability of students to plan, monitor, control, and evaluate themselves in learning activities (Ilmi et al., 2022). According to Rizqiani et al. (2023), SRL significantly improves the effectiveness of mathematical problem solving, and the better the SRL students have, the better their logical abilities. In line with Leana & Luthfi (2017), SRL is important in improving students' problem-solving abilities. This shows that SRL plays a role in the thinking process, including inductive thinking. SRL plays a role in improving students' mathematical reasoning abilities (Maulida et al., 2024), and the inductive approach can improve SRL (Amiruddin et al., 2022). Conceptually, SRL and mathematical reasoning are interrelated. SRL helps students organize information, recognize patterns, and draw logical conclusions, which are at the core of inductive reasoning.

Based on this description, this study analyzes and describes the inductive reasoning abilities of vocational high school students in solving contextual mathematical problems in geometric sequences. The difference between this study and previous studies lies in the focus of the analysis, which not only reviews the final results of problem solving but also examines the students' inductive reasoning process at each stage of solving the problem. In addition, inductive reasoning abilities are analysed by considering the students' Self-Regulated Learning (SRL) levels, which are classified into high, medium, and low categories. Through this approach, this study provides a more comprehensive picture of the relationship between inductive reasoning, SRL, and students' abilities in solving contextual mathematical problems. The problems used were compiled based on everyday contexts relevant to the application of geometric sequences, so that they could reveal more deeply the students' ability to relate mathematical concepts to real situations, recognize patterns, and draw logical conclusions, which are the core of inductive reasoning.

## **METHOD**

### ***A. Type of Research***

This study uses a qualitative approach. According to Creswell, J.W. & Guetterman (2018), the qualitative approach aims to explore and understand the meaning of a social or humanitarian issue. This type of research is used to analyze the inductive thinking abilities of vocational high school students in solving contextual problems related to geometric sequences. The qualitative approach was chosen to gain an in-depth understanding of the inductive thinking process of vocational high school students in solving contextual problems on geometric sequences as reviewed from Self-Regulated.

### ***B. Research Method***

The method used was a descriptive method that aimed to provide a systematic, factual, and accurate description of the facts and characteristics of the object being studied (Kristiyanti, 2023). The research population was grade XI students at SMK Negeri 1 Boyolali, with 33 grade XI Accounting and Institutional Finance students as subjects. The research objects included the SRL questionnaire and students' inductive reasoning abilities in solving contextual problems in geometric sequences. Sampling in this study used purposive sampling, which is the selection of data sources based on specific considerations (Sugiyono, 2019).

### ***C. Data Collection Techniques***

The first stage of the research began with administering the Self-Regulated Learning (SRL) questionnaire to students. The SRL questionnaire was compiled based on indicators proposed Zamnah (2019), including learning initiative, the ability to diagnose learning needs, setting learning goals, monitoring, managing, and controlling the learning process, the ability to see difficulties as challenges, utilizing and searching for relevant learning resources, selecting and determining appropriate learning strategies, evaluating the learning process and outcomes, and self-concept. The questionnaire instrument consisted of 25 statements, including 19 positive statements and 6 negative statements, with a score range of 1–4. The questionnaire results were then analyzed and grouped into three categories of SRL levels, namely low, medium, and high (Landa et al., 2024). The grouping of SRL levels was done by comparing the total SRL scores of each student with the mean ( $\bar{x}$ ) and standard deviation (SD) of the entire sample (Nugrahani et al., 2024). The mean ( $\bar{x}$ ) was obtained by dividing the total SRL scores of the students by the number of research subjects, which was 33 students, resulting in a value of 85.1. The standard deviation (SD) was calculated by taking the square root of the mean square difference between the students' SRL scores and the mean value, resulting in a value of 8.03. The total SRL score (N) was the score obtained by each student based on the results of completing the SRL questionnaire. Based on these criteria and calculations, the students' SRL levels were determined as follows [table 1](#):

**Table 1.** SRL

Interval	Score	Category
$N \geq (\bar{x} + SD)$	$N \geq 93,1$	<b>High</b>
$(\bar{x} - SD) < N < (\bar{x} + SD)$	$77,1 < N < 93,1$	<b>Medium</b>
$N \leq (\bar{x} - SD)$	$N \leq 77,1$	<b>Low</b>

Based on the results of the SRL grouping, two students from each group were selected to be tested with questions related to geometric sequences. The selection of two students in each category aimed to obtain an in-depth and representative picture of the students' thinking processes in solving geometric sequence problems at each SRL level. This number of subjects was considered adequate in descriptive qualitative research because it allowed the researcher to conduct an intensive analysis of the strategies, reasoning patterns, and differences in students' thinking characteristics in each SRL category. The assessment used indicators in accordance with Sosa Moguel et al. (2019), namely observing regularity, identifying important information from a problem, and finding regularities or patterns from the data, images, or numbers presented. Pattern formation involves organizing observations to find relationships between elements and formulating generalizations, namely developing general rules from the patterns found to solve similar problems. The inductive thinking ability test instrument has undergone content validation by mathematics education experts to ensure the suitability of the material, inductive reasoning indicators, and question context.

#### ***D. Data Analysis Techniques***

They were then interviewed about their written answers to explore their inductive reasoning abilities. Data analysis in this study involved three stages: data reduction, data presentation, and conclusion drawing (Miles et al., 2014). Data validity was ensured through triangulation techniques by comparing test and interview results.

## **RESULTS & DISCUSSION**

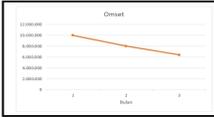
### ***Result.***

Based on the results of the study, the results of the SLR questionnaire given to 33 vocational high school students in grade 11 Accounting and Institutional Finance were obtained, as shown in [Table 2](#).

**Table 2.** Result SRL

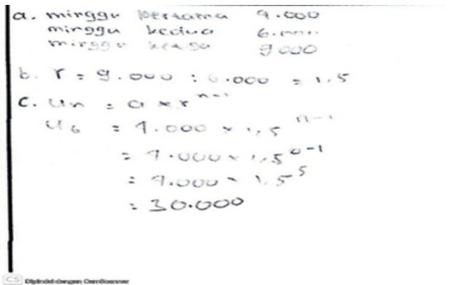
Category	Number of Students
High	3
Medium	24
Low	6

Based on the table, the results show that 3 students fall into the high SRL category, 24 fall into the medium SRL category, and 6 students fall into the low SRL category. Below are the research results and discussion of the students' work from each SRL category based on the results of the inductive reasoning ability test with 2 questions shown in [Figure 1](#).

<p>1 Rani saves money in a piggy bank every week. In the first week, she saves Rp. 4,000. A week later, in the second week, she saves Rp. 6,000. Then, in the third week, she saves Rp. 9,000.</p> <p>a. Write down the amount of money Rani saved in the first week, second week, and third week.</p> <p>b. Based on this data, determine the ratio of Rani's savings each week.</p> <p>c. Determine the general formula for calculating the amount of money Rani saves in week n, then calculate the amount saved in week 6.</p>	<p>2 A store sells cell phones, and its turnover has been declining every month for a year. The sales turnover data is shown in the graph below:</p> <div style="text-align: center;">  </div> <p>a. Write down sales data for the first three months.</p> <p>b. Based on this data, determine the ratio of monthly sales turnover.</p> <p>c. Using this formula, determine the store's sales turnover in the sixth month.</p>
--	--

**Figure 1.** Written questions to measure inductive reasoning.

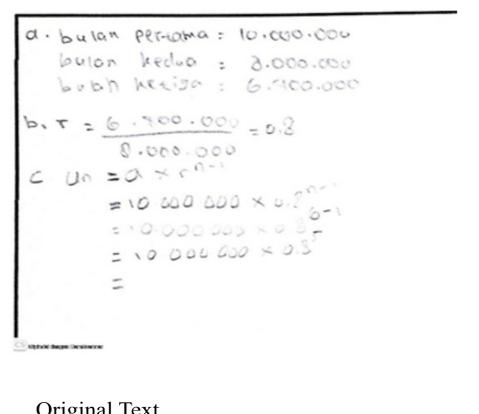
*Result of Inductive Reasoning in Students with High SRL Abilities*

 <p style="text-align: center;">Original Text</p>	<p>a. first week                    4.000              second week                6.000              third week                  9.000</p> <p>b. <math>r = 9.000 : 6.000 = 1.5</math></p> <p>c. <math>U_n = a \times r^{n-1}</math>  <math>U_6 = 4.000 \times 1,5^{6-1}</math>  <math>= 4.000 \times 1,5^{6-1}</math>  <math>= 4.000 \times 1,5^5</math>  <math>= 30.000</math></p> <p style="text-align: center;">Translated Text</p>
--	--

**Figure 2.** Answer Sheet for Inductive Reasoning of Students with High SRL Abilities

[Figure 2](#) shows the answer to question number 1 by students with high SRL abilities. The figure shows that students with high SLR abilities can answer question number 1 well. In point (a), students with high SLR abilities can write down the amount of savings saved in the first week as 4000, the second week as 6000, and the third week as 9000 correctly. This shows that students can observe the regularity of the data contained in the question. In question (b), students can determine the ratio by writing  $r = 9,000 : 6,000 = 1.5$ . This shows that students can form a pattern from the regularity found previously and can compile a generalization. This is demonstrated by the students' ability to compile a

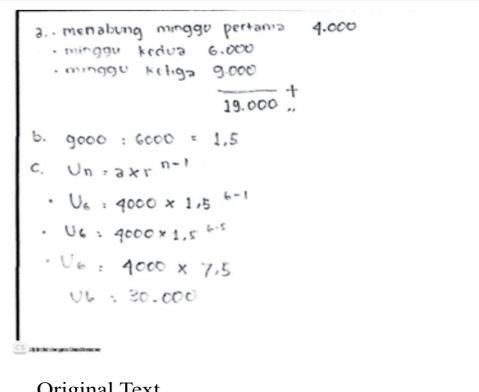
general formula and apply it to find the amount saved in the sixth week, but the ratio and final calculations are still incorrect.

 <p>Original Text</p>	<p>a. first month = 10.000.000 second month = 8.000.000 thrid month = 6.400.000</p> <p>b. <math>r = \frac{6.400.000}{8.000.000} = 0.8</math></p> <p>c. <math>U_n = a \times r^{n-1}</math> <math>= 10.000.000 \times 0.8^{n-1}</math> <math>= 10.000.000 \times 0.8^{6-1}</math> <math>= 10.000.000 \times 0.8^5</math> <math>=</math></p> <p>Translated Text</p>
--	---

**Figure 3.** Answer Sheet for Inductive Reasoning of Students with High SRL Abilities

[Figure 3](#) shows the answer to question number 2 for students with high SRL abilities. The figure shows that the student answered points (a), (b), and (c). In point (a), the student correctly writes down the turnover for the first month as 10.000.000, the second month as 8.000.000, and the third month as 6.400.000. This shows that students with high SRL abilities can observe patterns in questions. Students with high SRL abilities can write down the ratio requested in question (b), which is  $r = 6.400.000 : 8.000.000 = 0.8$ . This shows that students can form a pattern from the regularity found earlier and can compile a generalization, as shown by the students' ability to compile a general formula and apply it to find the amount of savings in the 6th month, but the calculation has not been completed. These findings indicate that moderate levels of self-regulated learning support pattern recognition and initial planning, but suboptimal metacognitive regulation limits the depth of students' inductive generalization processes.

#### Results of Inductive Reasoning in Students with Medium SRL Abilities

 <p>Original Text</p>	<p>a. first week = 4.000 second week = 6.000 thrid week = <math>\frac{9.000}{19.000} +</math></p> <p>b. <math>9.000 : 6.000 = 1.5</math></p> <p>c. <math>U_n = a \times r^{n-1}</math> <math>U_6 = 4.000 \times 1,5^{6-1}</math> <math>U_6 = 4.000 \times 1,5^{6-5}</math> <math>U_6 = 4.000 \times 7,5</math> <math>U_6 = 30.000</math></p> <p>Translated Text</p>
--	---

**Figure 4.** Answer Sheet for Inductive Reasoning of Students with Medium SRL Abilities

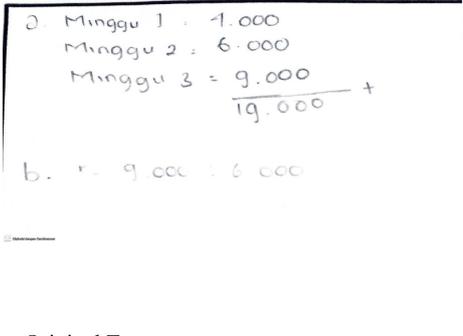
[Figure 4](#) shows the answer sheet of student number 1 with moderate SRL. Figure 3 shows that students with high SRL abilities can answer questions a, b, and c. In question a, students with high SLR abilities can write down the amount of savings in the first week as 4000, in the second week as 6000, and in the third week as 9000, but there is an error in perception in adding up the known totals. This shows that students with moderate SLR abilities can observe patterns in the questions but are not very good at it. Students with moderate SLR abilities can write down the ratio requested in question b, which is  $r = 9,000 : 6,000 = 1.5$ . This shows that students with moderate SRL abilities can form a pattern from the patterns found previously and attempt to form generalizations. This can be seen in Figure 4, where the student writes down the general formula for a geometric sequence even though the ratio calculation is incorrect and the final calculation is wrong. The student is also unable to write down the general formula requested in the question.

<p>a. Bulan pertama 10.000.000                      . Bulan kedua 8.000.000                      . Bulan ketiga 6.400.000</p> <p>b. <math>8.000.000 : 10.000.000 = 0,8</math></p> <p>c. <math>U_n = a \times r^{n-1}</math>  <math>U_6 = 10.000.000 \times 0,8^{6-1}</math>  <math>U_6 = 10.000.000 \times 0,8^5</math></p> <p style="font-size: small;">© Sekolah Dasar Cendekia</p> <p style="text-align: center;">Original Text</p>	<p>a. first month 10.000.000                      second month 8.000.000                      thrid month 6.400.000</p> <p>b. <math>= 8.000.0000 : 10.000.000 = 0.8</math></p> <p>c. <math>U_n = a \times r^{n-1}</math>  <math>U_6 = 10.000.000 \times 0.8^{6-1}</math>  <math>U_6 = 10.000.000 \times 0.8^5</math></p> <p style="text-align: center;">Translated Text</p>
--	---

**Figure 5.** Answer Sheet for Inductive Reasoning of Students with Medium SRL Abilities

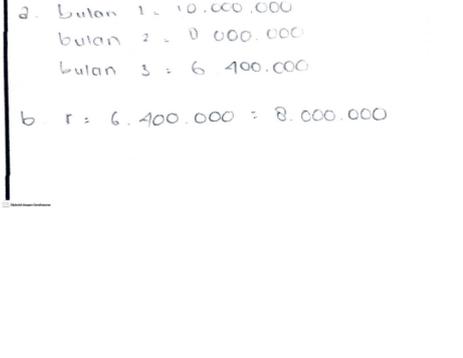
[Figure 5](#) shows the answer sheet of student number 2 with a moderate SRL category. In Figure 4, it can be seen that students with a moderate SRL category can answer points (a), (b), and (c). In point (a), students with moderate SRL again demonstrate their ability to observe regularity through their answers in point (a), by accurately writing down the data on the decline in turnover from the first month to the third month. Students are also able to identify patterns, as shown by the calculation of the ratio  $8,000,000 : 10,000,000 = 0.8$  in point (b). The students' efforts in formulating generalizations can be seen in point (c), where they wrote down the general formula for geometric sequences and began the calculation process, although the final result was not completed correctly. However, the students were unable to write down the general formula requested in point (c). These findings indicate that moderate levels of self-regulated learning support pattern recognition and initial planning, but suboptimal metacognitive regulation limits the depth of the process.

*Results of Inductive Reasoning in Students with Low SRL Abilities*

 <p>Original Text</p>	<p>a. week 1 = 4.000  week 2 = 6.000  week 3 = <math>\frac{9.000}{19.000}</math> +</p> <p>b. <math>r = 9.000 : 6.000</math></p> <p>Translated Text</p>
--	--

**Figure 6.** Answer Sheet for Inductive Reasoning of Students with Low SRL Abilities

[Figure 6](#) shows the answer sheet of student number 1 with a low SRL category. Figure 6 with a low SRL category shows a lack of ability to observe regularity. This can be seen from the answer in point (a), where the student can write down the savings data for the first, second, and third weeks and then add them up. However, the student did not correctly identify the pattern, as evidenced by the fact that students with low SRL were able to write the calculation result of the ratio  $9,000 \div 6,000$  in point (b). In addition, students with low SRL did not attempt to form a generalization, as evidenced by the fact that they did not write an answer in point (c).

 <p>Original Text</p>	<p>a. first month 10.000.000  second month 8.000.000  thrid month 6.400.000</p> <p>b. <math>r = 6.400.000 : 8.000.000</math></p> <p>Translated Text</p>
--	---

**Figure 7.** Answer Sheet for Inductive Reasoning of Students with Low SLR Abilities

[Figure 7](#) shows the answer sheet of student number 1 with a low SRL category. In Figure 7, with a low SRL category, the student shows good ability in observing regularity. This can be seen from the answer in point (a), where the student can write down the data on the decline in turnover in the first, second, and third months correctly. The student did not find the correct pattern, as evidenced by the fact that students with low SRL were able to write the calculation result of the ratio  $9,000 \div 6,000$  in point (b). In addition, students with low SLR did not attempt to form generalizations, as evidenced by the fact that they did not write an answer in point (c). These findings indicate that low self-regulated learning

limits students' metacognitive regulation, causing the inductive thinking process to stop at the observation stage.

## ***Discussion***

### *Inductive Reasoning in Students with High SRL Abilities*

[Figure 2](#) and [Figure 3](#) show the answer sheets of students with high SRL on inductive reasoning questions. Based on the analysis of the answers, students with high SRL were able to go through all stages of inductive reasoning, namely observing regularities, forming patterns, and constructing generalizations. This finding is in line with the research by Jusra & Rahmawati ([2022](#)), which states that the higher the self-regulated learning, the higher the students' mathematical reasoning abilities. Additionally, Van Vo & Csapó ([2020](#)) found that student performance on inductive reasoning tasks has a strong relationship with broader cognitive outcomes and achievement, emphasizing the importance of pattern recognition and generalization skills in solving complex tasks.

These findings are also supported by Panadero ([2017](#)), who states that students with good self-regulation tend to have more mature metacognitive abilities, enabling them to coordinate cognitive strategies effectively during the problem-solving process. Ismaili et al. ([2023](#)) emphasizes that self-regulated learning is an active and constructive process, in which students set learning goals, monitor progress, and reflect on learning outcomes continuously. In the context of this study, this ability is reflected in how students systematically manage strategies for solving inductive reasoning problems.

However, students with high SRL still show limitations in terms of accuracy, especially in the final calculation stage. This indicates that mastery of strategies and self-monitoring has not been fully balanced with optimal procedural control. These findings are in line with the systematic review by Alyani & Ramadhina ([2022](#)), which states that self-monitoring and strategy regulation contribute significantly to the quality of mathematical reasoning, but do not completely eliminate the possibility of technical errors in the problem-solving process. Overall, these findings indicate that self-regulated learning not only functions as a motivational factor, but also as a metacognitive regulator that determines the depth of students' inductive reasoning processes, even though high levels of SRL do not completely prevent procedural inaccuracies in complex problem-solving tasks.

### *Inductive Reasoning in Students with Medium SRL Abilities*

[Figure 4](#) and [Figure 5](#) show the answer sheets of students with moderate SRL abilities on inductive reasoning questions. The analysis results show that students with moderate SRL abilities are able to complete some stages of inductive reasoning, particularly in observing regularities and forming patterns. Students can accurately identify initial data and determine sequence ratios, which reflects their understanding of regularities and relationships between elements.

However, at the generalization stage, students with moderate SRL did not demonstrate optimal mastery. Although students wrote down the general formula for geometric sequences and began the calculation process, errors in determining the ratio and incomplete calculations resulted in generalizations that did not fully meet the requirements of the question. These findings indicate that students with moderate SRL have basic planning and monitoring abilities, but are not yet fully able to integrate this understanding into the formal generalization process.

These findings are in line with the results of research by Hasibuan et al. (2023) which states that students with moderate abilities tend to have difficulty determining and using general formulas correctly. In addition, other studies show that although SRL plays a role in supporting planning and reflection during problem solving, improvements in the ability to formulate formal generalizations, such as determining general formulas, occur more slowly and require explicit and structured practice (Kholid & Naufan, 2025). OECD (2019) reports that students with moderate self-regulation tend to be able to follow the initial procedures of mathematical problem solving but experience difficulties when faced with high-level cognitive demands, such as formal generalization and abstraction. This shows that success in inductive reasoning depends not only on the ability to recognize patterns but also on the ability to reflect on and verify thinking processes systematically. This shows that success in inductive reasoning depends not only on the ability to recognize patterns but also on the ability to reflect on and verify the thinking process systematically. Overall, these findings indicate that students with Self-Regulated Learning abilities are capable of inductive reasoning at the pattern recognition and formation stages, but limitations in metacognitive control and procedural verification limit the completeness and accuracy of the formal generalization process.

#### *Inductive Reasoning in Students with Low SRL Abilities*

Figure 6 and Figure 7 show the answer sheets of students with low SRL abilities on inductive reasoning questions. The analysis results show that students with low SRL are only able to complete the initial stage of inductive reasoning, which is observing patterns. In some parts, students are able to write down the initial data contained in the questions, such as the amount of savings or the decline in turnover in a certain period, but they are not yet able to identify the relationship between the data consistently. However, at the pattern formation stage, students with low SRL did not demonstrate adequate mastery. Errors in determining the sequence ratio indicate that students were unable to connect the observed regularities into a correct mathematical pattern. At the generalization stage, students with low SRL did not show any significant effort, as indicated by the absence of general formulas or answers in point (c). This condition indicates that the students' inductive reasoning process stopped at the observation stage and did not develop into formal generalization. These findings are in line with the research by Astiati & Ilham (2025), which states that students with low reasoning abilities are generally only able to observe regularities without being able to proceed to the stage of pattern formation and generalization. In

addition, Astuty et al. (2019) also revealed that students with low SRL have low mathematical reasoning abilities and tend to master only one indicator of inductive reasoning. Low planning, monitoring, and self-evaluation abilities prevent students from effectively controlling problem-solving strategies, thereby preventing the generalization process from taking place.

This study shows that students' inductive reasoning abilities vary systematically based on their SRL levels, thus answering the research objective to explore the role of SRL in supporting the stages of inductive reasoning in solving geometric sequences. Students with high SRL levels were able to go through all stages of inductive reasoning, namely observing patterns, forming patterns, and building generalizations, which reflects the integration of concept mastery and metacognitive control. On the other hand, students with moderate SRL showed partial mastery of inductive reasoning. Although students were able to observe patterns and form patterns, limitations in planning, monitoring, and evaluating strategies prevented them from formulating generalizations accurately. These findings indicate that the process of mathematical generalization requires a higher level of self-regulation than the pattern recognition stage. Meanwhile, students with low SRL show very limited inductive reasoning abilities, as the problem-solving process only stops at the stage of observing information. This confirms that low SRL limits the continuation and depth of students' inductive reasoning processes. Overall, the results of this study confirm that the higher the level of self-regulated learning, the more optimal the students' ability to go through all stages of inductive reasoning. Therefore, strengthening SRL, especially in the aspects of planning, monitoring, and reflecting on strategies, is an important factor in mathematics learning to support the development of students' inductive reasoning abilities. Further research is recommended to explore learning designs or pedagogical interventions that explicitly integrate SRL development to improve students' mathematical generalization abilities in the context of more complex problems. Overall, these findings indicate that low Self-Regulated Learning severely limits students' inductive reasoning processes, so that their thinking abilities only reach the observation stage and do not develop to the pattern formation or formal generalization stages due to weak metacognitive control.

## **CONCLUSION**

Based on the results of data analysis conducted at SMK Negeri 1 Boyolali, it can be concluded that students with high Self-Regulated Learning (SRL) abilities have good inductive reasoning skills, as they are able to fulfill three indicators of inductive reasoning, namely observing regularities, finding patterns, and forming generalizations. However, students still experience difficulties in the calculation aspect, particularly in determining ratios and calculating results. Students with moderate SRL abilities meet two indicators of inductive reasoning, namely observing regularities and finding patterns, but are not yet able to meet the indicator of formulating generalizations. This is due to the students' inability to formulate the formulas requested in the questions and to complete the calculations completely and

accurately. Meanwhile, students with low SRL abilities are only able to meet one of the three indicators of inductive reasoning, namely observing regularities. This condition is demonstrated by the students' ability to recognize data regularities but accompanied by errors in perceiving the sum of the data obtained from the questions. Students with low SRL are unable to find patterns and cannot formulate generalizations, nor do they record the results of ratio calculations or show any effort to construct generalizations. Overall, the results of this study confirm that the higher the level of self-regulated learning, the more optimal the students' ability to go through all stages of inductive reasoning. Therefore, strengthening Self-Regulated Learning, particularly in the aspects of planning, monitoring, and reflecting on strategies, is an important factor in mathematics learning to support the development of students' inductive reasoning abilities. Further research is recommended to explore learning designs or pedagogical interventions that explicitly integrate SRL development to improve students' mathematical generalization abilities in more complex problem contexts.

## REFERENCES

- Adeoye, M. A., & Jimoh, H. A. (2023). Problem-Solving Skills Among 21st-Century Learners Toward Creativity and Innovation Ideas. *Thinking Skills and Creativity Journal*, 6(1), 52–58. <https://doi.org/10.23887/tscj.v6i1.62708>
- Alyani, F., & Ramadhina, A. L. (2022). The Relation between Self-Regulated Learning and Mathematical Problem-Solving During Covid-19. *Journal of Education Research and Evaluation*, 6(4), 645–652. <https://doi.org/10.23887/jere.v6i4.47593>
- Amiruddin, A., Qorib, M., Naimi, N., & Deliaty, D. (2022). The Role of Inductive Learning Models on The Students Self-Regulated Learning in Math Journaling. *Cypriot Journal of Educational Sciences*, 17(7), 2428–2446. <https://doi.org/10.18844/cjes.v17i7.7680>
- Angraini, L. M., Larsari, V. N., Muhammad, I., & Kania, N. (2023). Generalization and Analogical Reasoning of Junior High School Viewed from Bruner's Learning Theory. *Infinity Journal*, 12(2), 291–306. <https://doi.org/10.22460/infinity.v12i2.p291-306>
- Anugraheni, I. (2019). Pengaruh Pembelajaran Problem Solving Model Polya Terhadap Kemampuan Memecahkan Masalah Matematika Mahasiswa. *Jurnal Pendidikan*, 4(1), 1–6. <https://doi.org/10.26740/jp.v4n1.p1--6>
- Astiati, S. D., & Ilham, I. (2025). Analisis Kemampuan Berpikir Induktif Matematis Siswa pada Mata Pelajaran Barisan Aritmatika. *Jurnal Pendidikan Dan Pembelajaran Indonesia (JPPI)*, 5(1), 319–328. <https://doi.org/10.53299/jppi.v5i1.995>
- Astuti, P., Sari, N. K., & Wirawan Fajar. (2023). Kemampuan Pemecahan Masalah Kontekstual Siswa SMA Kelas XI Pada Materi Barisan dan Deret. *ANTHOR : Education and Learning Journal*, 2(3), 396–401. <https://doi.org/10.31004/anthor.v2i3.152>
- Astuty, E. S. W., Waluya, St. Budi, & Sugianto. (2019). Mathematical Reasoning Ability Based on Self Regulated Learning by Using the Learning of Reciprocal Teaching with RME Approach. *Unnes Journal of Mathematics Education Research*, 8(1), 49–56. <http://journal.unnes.ac.id/sju/index.php/ujmer>
- BSKAP. (2025). Capaian Pembelajaran Mata Pelajaran Matematika Jenjang SMA/SMK fase E (Keputusan Kepala BSKAP No. 046/H/KR/2025).
- Cahyani, N. D., & Sritresna, T. (2023). Kemampuan Penalaran Matematis Siswa dalam Menyelesaikan Soal Cerita. *Jurnal Inovasi Pembelajaran Matematika: PowerMathEdu*, 2(1), 103–112. <https://doi.org/10.31980/pme.v2i1.1404>
- Creswell. J.W., & Guetterman, T. C. (2018). *Educational Research Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (6th ed.). Pearson.

- Evidiasari, S., & Irawati, S. (2019). Penalaran Induktif Siswa SMA Dalam Menyelesaikan Masalah Transformasi Geometri. *Jurnal Kajian Pembelajaran Matematika*, 3(2), 78–85. <http://journal2.um.ac.id/index.php/jkpm>
- Fathan, Y. A. (2025). Analisis Kemampuan Pemahaman Konsep Matematika Siswa SMK RPI Jakarta pada Materi Matriks. *Algoritma : Jurnal Matematika, Ilmu Pengetahuan Alam, Kebumihan Dan Angkasa*, 3(1), 190–195. <https://doi.org/10.62383/algoritma.v3i1.381>
- Hasibuan, D. S., Parta, I. N., & Qohar, A. (2023). Profil Penalaran Induktif Siswa SMP dalam Memecahkan Masalah Numerasi pada Materi Pola Bilangan. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 12(3), 3387. <https://doi.org/10.24127/ajpm.v12i3.7279>
- Ilmi, N. J., Mursidik, E. M., & Kurniawati, R. P. (2022). Self Regulated Learning pada Gaya Belajar Kinestetik Kelas V Sekolah Dasar. *Prosiding Konferensi Ilmiah Dasar*, 3, 276–281. <http://prosiding.unipma.ac.id/index.php/KID>
- Ismali, R. N., Yerizon, & Fauzan, A. (2023). Exploring Self-Regulated Learning and Their Impact on Students' Mathematical Communication Skills on the Topic of Number Patterns With the Blended Learning System Rafki Nasuha Ismail Universitas Negeri Padang Yerizon Universitas Negeri Padang. *Journal of Higher Education Theory and Practice*, 23(16), 207. <https://doi.org/https://doi.org/10.33423/jhetp.v23i16.6477>
- Izzah, K. H., & Azizah, M. (2019). Analisis Kemampuan Penalaran Siswa dalam Pemecahan Masalah Matematika Siswa Kelas IV. *Indonesian Journal Of Educational Research and Review*, 2(2). <https://doi.org/http://doi.org/10.23887/ijerr.v2i2.17629>
- Jusra, H., & Rahmawati, A. D. (2022). Analysis of Students Mathematical Reasoning Abilities in Terms of Self-Regulated Learning. In *Jurnal Inspirasi Pendidikan* (Vol. 12, Number 2).
- Kementerian Pendidikan dan Kebudayaan Republik Indonesia. (2017). *Matematika untuk SMA/MA/SMK/MK Kelas XI (2017 Revisi)*. Kementerian Pendidikan dan Kebudayaan Republik (Kemendikbud RI).
- Kholid, M. N., & Naufan, F. (2025). Next-Level Learning: Classifying Self-Regulated Learning in Mathematical Problem-Solving. *Educational Process: International Journal*, 17. <https://doi.org/10.22521/edupij.2025.17.390>
- Kristiyanti, M. (2023). *Metode Penelitian* (D. Abimanto, Ed.). CV. Pustaka STIMART AMNI Semarang.
- Landa, J., Berciano, A., & Marbán, J. M. (2024). Self-Regulation Profiles of Pre-Service Mathematics Teachers for Primary Education in Mathematical Problem-Solving Contexts. *Education Sciences*, 14(9). <https://doi.org/10.3390/educsci14091018>
- Leana, K. L., & Luthfi, A. K. (2017). Systematic Literature Review: Pengaruh Self-Regulated Learning Terhadap Kemampuan Pemecahan Masalah Matematika Siswa Berdasarkan Jenjang Pendidikan. *Jurnal Penelitian Dan Penalaran*, 11(2), 21–30. <https://doi.org/https://doi.org/10.26618/jp.v11i2.15919>
- Magfiroh, M., Prabawanto, S., & Rosjanuardi, R. (2024). Learning Obstacle of Students in Geometrical Sequence and Series. *KnE Social Sciences*. <https://doi.org/10.18502/kss.v9i13.15960>
- Maulida, A. S., Wahyudin, W., Turmudi, T., & Nurlaelah, E. (2024). Differences in The Influence of Self-Regulated Learning Levels on Enhancing Students' Mathematical Reasoning Abilities. *DWIJA CENDEKIA: Jurnal Riset Pedagogik*, 8(2), 221. <https://doi.org/10.20961/jdc.v8i2.89291>
- Medyasari, T. L., Zaenuri, & Dewi, N. R. (2020). Kemampuan Pemecahan Masalah Matematis Siswa SMA Negeri 5 Semarang. *PRISMA, Prosiding Seminar Nasional Matematika*, 3, 464–470. <https://journal.unnes.ac.id/sju/index.php/prisma/>
- Miles, M. B., huberman, M., & Saldana, J. (2014). *Qualitative Data Analysis A Methods Sourcebook*. SAGE Publications, Inc.
- Mulyasari, Y. (2018). Inductive Approach Implementation to Improve the Mathematichal Reasoning, Problem-Solving, and Self-Concept of Junior High School Student in Karawang District. *PRISMA*, 7(2), 186–196. <https://jurnal.unsur.ac.id/prisma>

- Nugrahani, R. P., Nurcahyo, A., & Kholid, M. N. (2024). Analisis Kemampuan Berpikir Reflektif Matematis Siswa pada Materi Statistika Ditinjau dari Self-Regulated Learning. *Lebesgue: Jurnal Ilmiah Pendidikan Matematika, Matematika Dan Statistika*, 5(1), 232–242. <https://doi.org/10.46306/lb.v5i1>
- Nurcahyani, M. J., & Sumardi, S. (2022). Meningkatkan Kemampuan Pemecahan Masalah Peserta Didik Melalui Pembelajaran Berbantuan LKPD Berbasis Discovery Learning. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 11(4), 3624. <https://doi.org/10.24127/ajpm.v11i4.5765>
- Nursoffina, M., & Efendi, N. (2021). Analysis of The Relationship Between Mathematical Reasoning and Problem Solving of Elementary Students Mathematics Material. *Academia Open*, 6. <https://doi.org/10.21070/acopen.6.2022.1813>
- OECD. (2019). Development Co-operation Report 2019 (Development Co-Operation Report). OECD Publishing. <https://doi.org/10.1787/9a58c83f-en>
- OECD. (2023). PISA 2022 Results (Volume I): The State of Learning and Equity in Education. (PISA). OECD Publishing. <https://doi.org/10.1787/53f23881-en>
- Panadero, E. (2017). A review of Self-Regulated Learning: Six Models and Four Directions for Research. In *Frontiers in Psychology* (Vol. 8, Number APR). Frontiers Media S.A. <https://doi.org/10.3389/fpsyg.2017.00422>
- Polya, G. (2004). *How to Solve it A New Aspect of Mathematical Method*. Princeton University Press.
- Prameswari, A. D., & Abadi, A. P. (2025). Analisis Kemampuan Pemecahan Masalah Siswa Kelas X SMA pada Materi Barisan Aritmetika. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, 9(3), 486–497. <https://doi.org/10.31004/cendekia.v9i1.3954>
- Putri, R. D. R. P., Ratnasari, T., Trimadani, D., Halimatussakdiah, Husna, E. N., & Yulianti, W. (2022). Pentingnya Keterampilan Abad 21 dalam Pembelajaran Matematika. *Science and Education Journal (SICEDU)*, 1(2), 449–457. <http://doi.org/10.31004/sicedu.v1i2.64>
- Rahmatika, D., & Waluya, S. B. (2023). Students' Mathematical Reasoning Ability Viewed from Self-Regulated Learning in The Missouri Mathematics Project Learning with Open-Ended Approach. *Unnes Journal of Mathematics Education*, 12(1), 84–92. <https://doi.org/10.15294/ujme.v12i1.66188>
- Rizqiani, A. S., Sridana, N., Junaidi, J., & Kurniati, N. (2023). Analisis Kemampuan Pemecahan Masalah Matematis dalam Menyelesaikan Soal Cerita Ditinjau dari Kemampuan Berpikir Kritis Siswa. *Jurnal Ilmiah Profesi Pendidikan*, 8(1), 232–239. <https://doi.org/10.29303/jipp.v8i1.1138>
- Siswanto, E., & Meiliasari. (2024). Kemampuan Pemecahan Masalah pada Pembelajaran Matematika: Systematic Literature Review. *Jurnal Riset Pembelajaran Matematika Sekolah*, 8(1), 45–59. <https://doi.org/http://doi.org/10.21009/jrpms.081.06>
- Sosa Moguel, L. E., Aparicio Landa, E., & Cabañas-Sánchez, G. (2019). Characterization of Inductive Reasoning in Middle School Mathematics Teachers in a Generalization Task. *International Electronic Journal of Mathematics Education*, 14(3). <https://doi.org/10.29333/iejme/5769>
- Sugiyono. (2019). *Metode Penelitian Kuantitatif Kualitatif dan R&D*. Alfabeta.
- Tasoin, F. A. L., & Adibah, F. (2024). Analisis Kemampuan Matematika Siswa dalam Menyelesaikan Soal Cerita pada Materi pada Materi Barisan dan Deret geometri. *Journal of Education and Research*, 3(1), 77–88. <https://doi.org/https://doi.org/10.56707/jedar.v3i1.189>
- Tukaryanto, Hendikawati, P., & Nugroho, S. (2018). Peningkatan Kemampuan Penalaran Matematik dan Percaya Diri Siswa Kelas X Melalui Model Discovery Learning. *Prosiding Seminar Nasional Matematika*, 656–662. <https://journal.unnes.ac.id/sju/index.php/prisma/>
- Van Vo, D., & Csapó, B. (2020). Development of Inductive Reasoning in Students Across School Grade Levels. *Thinking Skills and Creativity*, 37. <https://doi.org/10.1016/j.tsc.2020.100699>
- Wardani, R. K., & Amidi. (2025). Kemampuan Penalaran Matematis Ditinjau dari Minat Belajar Siswa dengan Model Problem Based Learning Berbantuan Mathigon. *Jurnal Ilmiah Literasi Indonesia*, 1(1), 183–193. <https://doi.org/10.63822/s0amny98>

- Wibowo, T., Susianti, E., Nugraheni, P., & Purwoko, R. Y. (2024). Students' Onto-Semiotic Approach in Solving Mathematics Problems. *Jurnal Riset Pendidikan Matematika*, 11(1), 1–14. <https://doi.org/10.21831/jrpm.v11i1.51973>
- Wijayanti, R. (2022). Pembelajaran Matematika dengan Kontekstual Untuk Meningkatkan Kemampuan Penalaran Induktif pada Siswa kelas VIII SMP Negeri 11 Kota Cirebon. *Jurnal Pendidikan Intelektium*, 3(2), 382–388. <https://doi.org/https://doi.org/10.37010/int.v3i2.1081>
- Yuwono, T., & Murniasih, T. R. (2024). Students' Mathematical Connection Ability in Solving Problems. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 13(1), 124. <https://doi.org/10.24127/ajpm.v13i1.3500>
- Zamnah, L. N. (2019). Analisis Self-Regulated Learning yang Memperoleh Pembelajaran Menggunakan Pendekatan Problem-Centered Learning dengan Hands-on Activity. *ANARGYA: Jurnal Ilmiah Pendidikan Matematika*, 2(1), 56–63. <https://doi.org/https://dx.doi.org/1024176/anargya.v2i1.3495>