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Creative Reasoning Ability of Students Based on Intrinsic Cognitive Load

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Abstrak

Kemampuan penalaran kreatif matematis merupakan kemampuan yang penting untuk dikuasai siswa. Kenyataannya, kemampuan penalaran kreatif matematis siswa cenderung bermasalah. Salah satu hal yang diyakini berpengaruh terhadap kesulitan siswa dalam memecahkan masalah pada matematika adalah beban kognitif *intrinsic* yang dihadapi. Oleh karena itu, penelitian ini bertujuan untuk mengungkapkan secara mendalam gambaran kemampuan penalaran kreatif siswa ditinjau berdasarkan beban kognitif *intrinsic*. Penelitian ini menggunakan pendekatan kualitatif dengan desain fenomenologi. Subjek penelitian ini adalah siswa kelas VIII di salah satu MTs Negeri di Kabupaten Lima Puluh Kota, Provinsi Sumatera Barat yang telah mempelajari materi bangun ruang sisi datar. Data dikumpulkan melalui teknik tes dan wawancara. Hasil penelitian menunjukkan bahwa siswa yang memiliki beban kognitif *intrinsic* rendah dapat melakukan penalaran kreatif matematis dengan cukup konsisten. Siswa yang memiliki beban kognitif *intrinsic* sedang cukup bisa melakukan penalaran kreatif matematis tetapi belum konsisten. Sedangkan siswa yang memiliki beban kognitif *intrinsic* tinggi hampir tidak dapat melakukan penalaran kreatif matematis. Sebagai kesimpulan, diperoleh bahwa semakin rendah beban kognitif *intrinsic* yang dialami_siswa, semakin baik kemampuan penalaran kreatif matematis yang ia miliki. Berdasarkan kesimpulan tersebut, direkomendasikan untuk melakukan penelitian yang mengacu kepada penggunaan desain pembelajaran yang tepat untuk mengembangkan kemampuan penalaran kreatif matematis siswa pada masa yang akan datang.

Kata kunci: Penalaran Kreatif Matematis, Beban Kognitif *Intrinsic,* Bangun Ruang Sisi Datar

Abstract

Mathematical creative reasoning is an essential ability for students. In reality, students' mathematical creative reasoning skills tend to be problematic. One thing that is believed to affect students' difficulties in solving problems in mathematics is the intrinsic cognitive load they face. Therefore, this study aims to describe students' creative reasoning abilities regarding intrinsic cognitive load in depth. This study uses a qualitative approach with a phenomenological design. The subjects of this study were students of class VIII from one of the state Islamic junior high schools in Lima Puluh Kota Regency, West Sumatra Province, which studied the materials for flat and solid geometry. Data was collected through test and interview techniques. The study results show that students with low intrinsic cognitive load can consistently perform creative mathematical reasoning. Students with moderate intrinsic cognitive load can do creative mathematical reasoning but are inconsistent. Meanwhile, students with a high intrinsic cognitive load can almost not do creative mathematical reasoning. In conclusion, it is found that the lower the intrinsic cognitive load experienced by students, the better their creative mathematical reasoning abilities will be. Based on the conclusion, research is recommended to use suitable learning designs to develop students' mathematical creative reasoning skills in the future.

Keywords: Creative Mathematical Reasoning, Intrinsic Cognitive Load, Flat And Solid Geometry

1. INTRODUCTION

Mathematical reasoning is considered one of the essential abilities to be mastered by students in 21st-century learning. Callingham (2021) and OECD (2019) stated that 21st-century skills, including mathematical reasoning, must be mastered by students in learning mathematics at all levels, starting from primary, secondary, to tertiary levels. Nurjanah (2021), Şen (2021), Mardhayanti (2020), and Norqvist et al. (2019) explain that mathematical reasoning is needed to make conclusions based on logic. However, problem-solving proofs that require mathematical reasoning are still difficult for scholars to learn (Gusmawan et al., 2021). In contrast, mathematical reasoning skills are needed to develop students' mathematical understanding (Olsson & Granberg, 2022). If there is no development of students' mathematical reasoning in learning, then mathematics is just like a set of procedures that are carried out without knowing why these procedures are carried out. Therefore, mathematical reasoning ability is one of the fundamental aspects of learning mathematics.

As a fundamental aspect, mathematical reasoning abilities need serious attention in learning mathematics. Making mathematical reasoning one of the goals of mathematics learning is one of the attentions that can be given. Kaplar (2022) and Seah dan Horne (2021) state that developing various types of students' mathematical reasoning is a fundamental goal of mathematics education. Based on the Regulation of the Minister of Education and Culture (Permendikbud) No. 58 of 2014 concerning guidelines for mathematics for junior high school / Islamic junior high school, the Indonesian government has taken steps to make mathematical reasoning one of the objectives of mathematics learning. Furthermore, the Regulation of the Minister of Education and Culture No. 21 of 2016 concerning content standards for elementary and secondary education states the importance of mathematical reasoning abilities in both the concrete and abstract domains as one of the mathematics learning objectives in school. The government's efforts to integrate mathematical reasoning abilities in learning are expected to help students develop their mathematical reasoning abilities, including creative mathematical reasoning.

Mathematical creative reasoning is an ability that requires students to use their creative thinking skills to solve a problem in a task. Creative thinking skills need to be mastered by students so that they are used to thinking critically, logically, systematically, carefully, and creatively in solving problems (Wardani et al., 2021). Regarding ideal competencies, junior high school students, like professional mathematicians, are expected to have high creativity to solve more challenging problems in the future (Permatasari et al., 2020). Mathematical creative reasoning relates to students' efforts in providing solution strategies that they develop themselves in solving problems or modifying steps from previously learned concepts, formulas, or algorithms (Jonsson et al., 2022; Kusaeri et al., 2022; Olsson & Granberg, 2022). Mathematical creative reasoning is generally used to solve non-routine problems that require a construction process of mathematical reasoning. The fact shows that students' mathematical creative reasoning abilities tend to be problematic. The study results by Agusti et al. (2023) and (Sukirwan et al., 2018) show that junior high school students still use routine procedures or reason imitatively when faced with questions requiring creative reasoning. In comparison, creative reasoning is more efficient in the long term than imitative reasoning (Jonsson, Mossegård, Lithner, & Karlsson Wirebring, 2022; Norqvist, Jonsson, Lithner, Qwillbard, & Holm, 2019). Therefore, it is necessary to pay special attention to mathematical creative reasoning abilities so that students can overcome difficulties in solving problems in learning mathematics.

One thing that is believed to affect students' difficulty in solving problems in mathematics is the cognitive load. Cognitive load theory is a theory that links learning and problem-solving with the amount of resources and mental effort required for a given task (Ayres et al., 2021). Many factors can affect cognitive load, including learning strategies, task difficulty, and prior knowledge (Gupta, 2020). If these factors are not adequately controlled, it will impact increasing cognitive load and cause the student's problem-solving process to be disrupted. Sweller et al. (2019) state that a high level of interactive elements in the problem-solving process increases a person's cognitive load, so he has difficulty understanding learning material. It means mastery of learning material is related to the cognitive load.

One type of cognitive load closely related to learning materials is intrinsic cognitive load. As stated by Gupta & Zheng (2020), intrinsic cognitive load is related to the complexity of the subject matter. This theory explains why the material difficulty level differs from one material to another and how this affects the load on memory (Jong, 2010). Investigating intrinsic cognitive load will help teachers understand the complexity of the material experienced by students (Klepsch & Seufert, 2020). The intrinsic cognitive load will be high if the material comprises many interrelated elements to form complex bonds. Conversely, the intrinsic cognitive load will be low if the material is not too complicated to be learned. It indicates the problems in students' mathematical creative reasoning ability, which is thought to be related to the intrinsic cognitive load experienced. As far as theoretical studies have been carried out, no in-depth research has examined the relationship between students' mathematical creative reasoning abilities and their intrinsic cognitive load. Therefore, this study aims to analyze students' mathematical creative reasoning abilities in depth based on intrinsic cognitive load.

2. METHOD

This research uses a qualitative approach with a phenomenological design. A phenomenological design chooses to obtain an in-depth understanding of students' mathematical creative reasoning abilities based on intrinsic cognitive load. The research subjects were 25 students of grade VIII in the 2022/2023 academic year who had studied the material of flat and solid geometry. The research was conducted at an Islamic junior high school in Lima Puluh Kota Regency, West Sumatra Province. Data collection techniques used were test and interview techniques. The test technique in this study aims to obtain an overview of students' intrinsic cognitive load and creative mathematical reasoning abilities. Meanwhile, the interview technique was conducted to validate students' answers and dig deeper into students' mathematical creative reasoning abilities.

The main instruments in this study were the researchers themselves, and the supporting instruments consisted of intrinsic cognitive load tests, mathematical creative reasoning abilities tests, and interview guides. The intrinsic cognitive load test uses a task complexity worksheet test adopted from Brünken dkk. (2010). The scale used to classify students' intrinsic cognitive load was adapted from the scale used by Tejamukti & Masalah (2017) as follows.

Table 1. Category of Students' Intrinsic Cognitive Load

Number	Interval	Category
1	$x \geq mean + SD$	Low
2	$mean - SD < x < mean + SD$	Moderate
3	$x \leq mean - SD$	High

Notes: x = Students' intrinsic cognitive load score
mean = An average of students' intrinsic cognitive load score
SD = The standard deviation of students' intrinsic cognitive load score

Based on Table 1, students' intrinsic cognitive load is low if the student's score is more than mean + SD. Students' intrinsic cognitive load is high if the student's score is less than mean + SD. Then, the intrinsic cognitive load is moderate if the student score other than that.

The mathematical creative reasoning test uses three indicators, including mathematical foundation, plausibility, and novelty, adopted from Bergqvist (Birkeland, 2019). These indicators will explain in detail the components that will be assessed related to creative mathematical reasoning developed by Kusaeri dkk. (2021) in Table 2.

Table 2. Component of Creative Mathematical Reasoning Indicator

Indicator of Creative Mathematical Reasoning	Component
Mathematical foundation	• Mention the information/known things. • Mention what is being asked. • Determine the strategy based on the intrinsic nature of mathematics relevant to the known and questioned. • Apply the strategy that has been chosen.
Plausibility	• Explains the relationship of the known things. • Explains the correspondence between what is known and what is asked. • Provide logical reasoning related to the solution strategy and the application of the developed strategy. • Explains the suitability of the results obtained with the task question.
Novelty	• Develop at least one element of novelty in the problem-solving sequence. • Apply the strategies that have been developed in problem-solving.

(Kusaeri dkk., 2021)

Furthermore, the data was analyzed through several stages: reduction, display, and conclusion drawing/verification.

3. RESULT AND DISCUSSION

Students' mathematical creative reasoning was identified through essay questions related to flat and solid geometry. Previously, a cognitive load test was conducted to categorize students based on intrinsic cognitive load. The following describes the results obtained regarding the intrinsic cognitive load of students.

A. Intrinsic Cognitive Load

The intrinsic cognitive load test aims to group students based on intrinsic cognitive load experienced with high, moderate, and low categories. After the test was carried out, the researchers calculated the score obtained by each student. The categorization of students' intrinsic cognitive load tests can be seen in Table 3 below.

Table 3. Recapitulation of Students' Intrinsic Cognitive Load Category

Number	Interval	Category	Frequency	Percentage (%)
1	$x \geq 60{,}30$	Low	4	16
2	$1{,}82 < x < 60{,}30$	Moderate	20	80
3	$x \leq 1{,}82$	High	1	4
		Total	25	100

Based on Table 3, it was found that the highest number of students was in the moderate intrinsic cognitive load category, namely 20 people. Meanwhile, the number of students in the high intrinsic cognitive load category was only one person, and the number of students in the low intrinsic cognitive load category was four people. After analyzing students' intrinsic cognitive load, the results of the analysis of students' mathematical creative reasoning abilities tests will be presented based on cognitive load. An overview of students' mathematical creative reasoning abilities is presented through 3 examples of student work that meet the classification of high, moderate, and low intrinsic cognitive load. Information from the three subjects is described in Table 4 below.

Table 4. Data of Research Subject

Number	Cognitive Load	Category	Student
1.		Low	S1
2.	*Intrinsic*	Moderate	S2
3.		High	S3

B. Creative Mathematical Reasoning Abilities of Students Based on Intrinsic Cognitive Load

1) Subject S1

S1 completed all the questions given in the mathematical creative reasoning ability test. The following is S1's answer to question number 1.

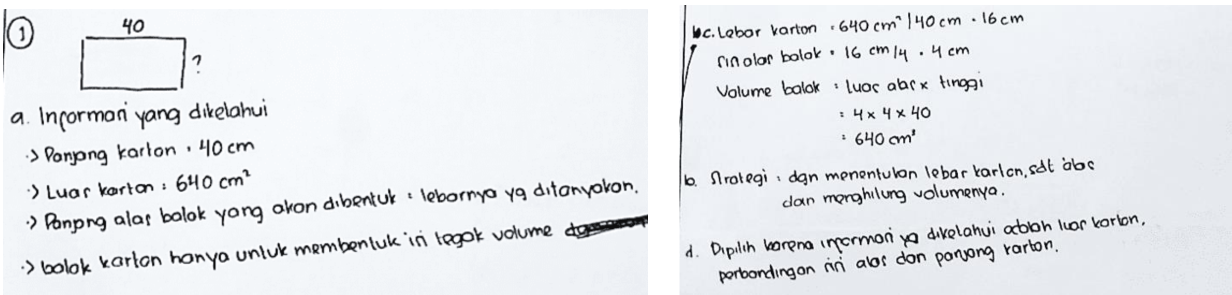

Figure 1. Test Result of S1 on Question Number 1

Based on Figure 1, S1 correctly wrote the information known in problem 1a but did not write the information asked. However, S1 can explain when interviewed that the information asked is the volume of the cuboid. In problem 1b, S1 could write down the steps to answer the problem in detail. Then, S1 applied the strategy correctly in problem 1c. There are differences in the cuboid volume formula used by S1 with the commonly used p×l×t. However, the formula is correct mathematically and can be used because p×l = rectangular base. It shows that S1 can determine the relevant strategy and apply the strategy that has been chosen. Thus, S1 has met the first indicator of mathematical foundation.

The second indicator is plausibility. S1 can see the relationship between known and questioned information so that S1 can determine the volume of the cuboid. During the interview, S1 explained that the solution strategy chosen was adjusted to the information stated in the problem. One of the pieces of information was that the length and width of the cuboid had the same size. Therefore, S1 decided to divide the four equal-length cartons horizontally. It means that S1 has been able to provide logical reasons related to the solution strategy used. Then, the results were obtained following the task question. In the third indicator, novelty, S1 can develop creative ideas to determine the length and width of the cuboid by dividing the cartons horizontally and the same length. S1 can develop at least one element of novelty in a series of problem-solving and apply the strategies developed to solve the problem. Thus, it can be said that subject S1 can fulfill the novelty indicator. Based on the description of the student's answer to question number 1, S1 fulfills all indicators of creative mathematical reasoning. It can be concluded that S1 can do creative mathematical reasoning well in solving problems. It is in line with the research result by Yuniar (2019) that students with low intrinsic cognitive load can solve the problem properly. The following is S1's answer to question number 2.

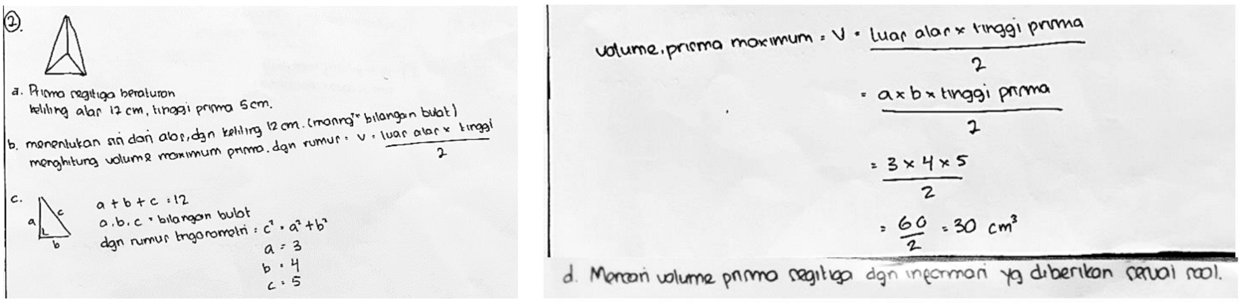

Figure 2. Test Result of S1 on Question Number 2

Based on Figure 2, S1 can write the general information in problem 2a and correctly mention the information asked through the interview. S1 understood the steps to be taken. It can be seen in the answer to question 2b. However, there was a mistake in determining the maximum volume of the prism. S1 only determined the volume for prisms whit right triangle base. Based on the information from the question, the prism's base is a regular triangle, so three possible base shapes can be used: a right triangle, an isosceles triangle, and an equilateral triangle. The three bases have different areas, so they impact the difference in volume produced. The maximum volume of the prism will be obtained from three different volumes. It means that S1 does not understand the solution strategy that will be used, so there are errors in its application in the answer sheet. Thus, S1 has not fully met the mathematical foundation indicator. It is in line with the research result by Kusaeri et al. (2021), which states that if one solution does not involve calculation, the solution does not fulfill one of the mathematical foundation indicators.

Furthermore, S1 can see the relationship between the perimeter of the prism's base and the prism's volume so that he comes up with steps to determine the side of the prism's base that will be used in calculating the prism's volume. S1 can explain the relationship between general information and see the suitability between known and asked information. Through the interview, S1 explained that the side of the prism's base must be determined first. In this case, S1 used a right triangle base shape. However, he could not provide a logical reason why the base of the prism he used was a right triangle. Furthermore, the final result did not follow the problem question. Thus, S1 has not been able to fulfill the plausibility indicator. In the third indicator, novelty, S1 can develop creative ideas by visualizing the regular triangle as a right triangle. It is a novelty in the series of problem-solving. S1 can apply the strategies that have been developed to solve the problem. Based on the description of the student's answer to question number 2, S1 not fully met all indicators of creative mathematical reasoning. It can be concluded that S1 has not been able to do creative mathematical reasoning well in solving problem number 2. Thus, S1 can fulfill the novelty indicator. The following is S1's answer to question number 3.

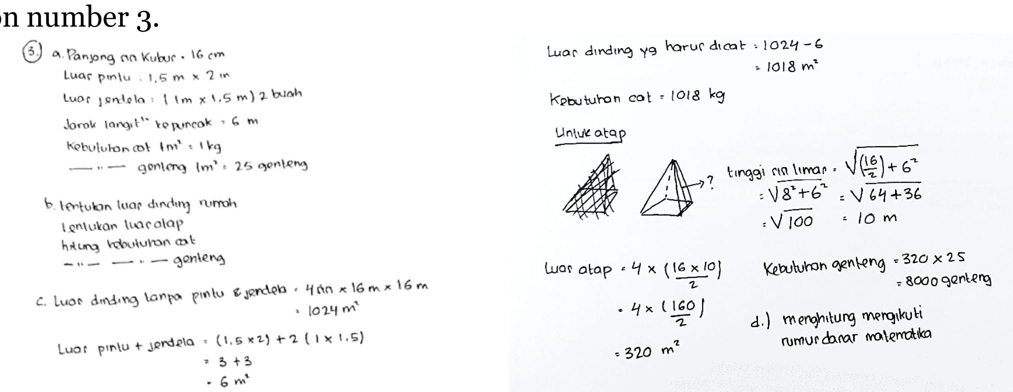

Figure 3. Test Result of S1 on Question Number 3

Based on Figure 3, S1 wrote the general information ultimately and mentioned the information asked correctly during the interview. He can provide an organized solution strategy so that he can apply the strategy to determine the solution to problem number 3. It shows that he can determine the relevant strategy and apply the strategy that has been chosen. Thus, S1 has been able to fulfill the mathematical foundation indicator. In the second indicator, plausibility, S1 can utilize the available information to determine the wall area that needs to be painted and the roof area to be tiled. By utilizing the question states that the need for every $1m^2$ of the wall is 1 kg of paint, and the need for every $1m^2$of the roof is 25 tiles. S1 can determine the actual paint and tiles needed. S1 can explain the relationship between known things and see the suitability between known and asked information.

Furthermore, in the interview session, S1 explained that he calculated only four sides to determine the area of the walls in the cube-shaped because the other two sides were the ceiling and floor. Then, there is no need to calculate the base area of a pyramid to determine the roof area to be tiled. Furthermore, the Pythagorean theorem must be used to determine the height of the lateral face of the pyramid. Subject S1 can already provide logical reasons for the solution strategy. Then, the results were obtained following the task question. Thus, S1 has fulfilled the plausibility indicator in problem number 2. In the third indicator, novelty, S1 explained that question number 3 is non-routine. In this problem, students are required to modify the formula for the surface area of cubes and pyramids to suit the needs of the problem. S1 can bring out novelty through his creativity and logical thinking so that the weight of paint and the number of tiles needed are obtained. Thus, subject S1 can already fulfill the novelty indicator in question number 3. Based on the description of the student's answer to question number 3, S1 fulfills all indicators of creative mathematical reasoning. S1 can perform creative mathematical reasoning in this problem because S1 understands the matter well. Ayres et al. (2021) said that learners with a high level of expertise have a knowledge structure (schema) that allows them to combine many elements, thus reducing the intrinsic cognitive load in solving problems. The following is S1's answer to question number 4.

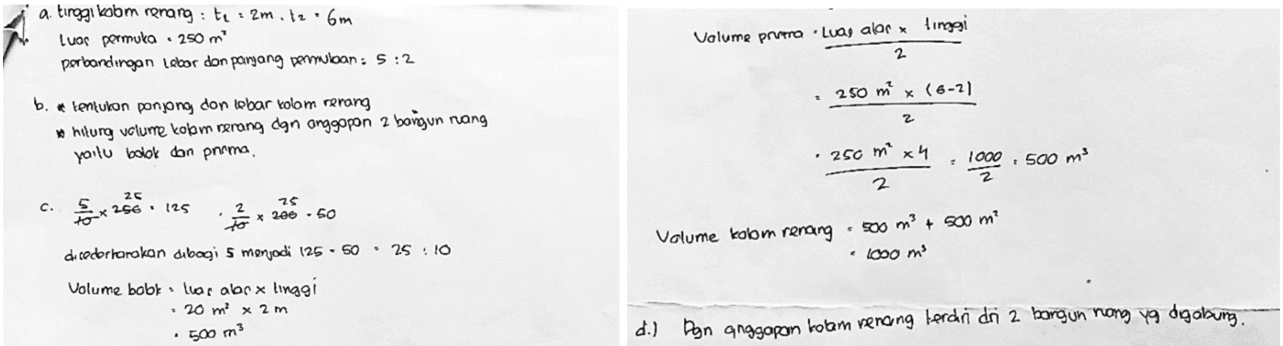

Figure 4. Test Result of S1 on Question Number 4

Based on Figure 4, S1 can write down the general information and add the information asked through the interview. He understood the steps to be taken so that he could apply the steps to determine the solution to problem number 4. It shows that he can determine the relevant strategy and apply the strategy that has been chosen. However, there were errors in the calculation operations used by S1 in determining the length and width of the swimming pool surface, even though the answer was correct. He forced some of the numbers used for division and multiplication operations when determining the rectangle's length and width, resulting in inconsistent calculations. S1 admitted that length = 25 cm and width = 10 cm were obtained from the ratio of 5 and 2, but S1 did not know what kind of calculation to write. S1 has not fully applied the solution strategy on the answer sheet. Thus, S1 has fulfilled the mathematical foundation indicators in problem number 4, but not perfect.

In the second indicator, plausibility, S1 can see the relationship between available information and the suitability between known and asked information. Through interviews, S1 can provide logical reasons for the solution strategy used to determine the maximum volume of the swimming pool—furthermore, the solution obtained following the task question. Thus, S1 fulfills the plausibility indicator in problem number 2. In the third indicator, novelty, S1 explained that the model of problem number 4 had never been done previously. S1 is required to reason so S1 can determine the type of solid figures that forms the swimming pool to determine the maximum volume of the swimming pool. In this problem, S1 can bring out novelty through his creativity and logical thinking by dividing the swimming pool sketch into two figures: a cuboid and a prism with a triangular base. Thus, S1 has fulfilled the novelty indicator. Based on the description of the student's answer to question number 4, S1 fulfills all indicators of creative mathematical reasoning. It can be concluded that S1 can do creative mathematical reasoning well in solving problems.

Overall, S1 has been able to do creative mathematical reasoning well and almost consistently. S1 mastered the flat and solid geometry material and could apply it in problem-solving. Following the research of Yuniar et al. (2019), students with low intrinsic cognitive load have an excellent ability to solve problems in the given math problems.

2) Subject S2

S2 worked on the answers to 3 of the four questions, but S2 did not work on problem number 3 until it was finished. The following is S2's answer to question number 1.

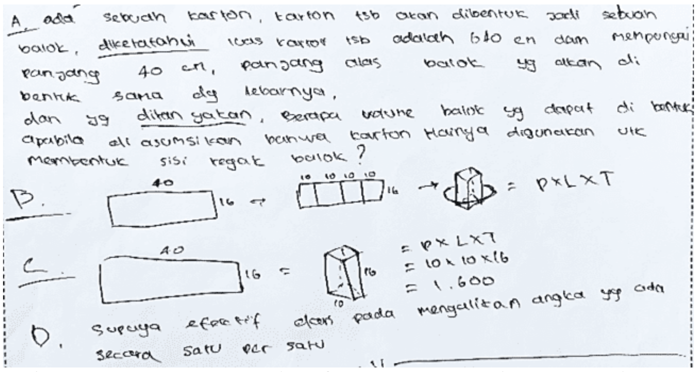

Figure 5. Test Result of S2 on Question Number 1

Based on Figure 5, S2 can completely write the general and questionable information in question 1a. S2 explained the strategy used in the form of a picture. When interviewed, S2 could verbally explain the steps of solving the problem. It shows that S2 has determined the relevant strategy and then applied the strategy chosen in question 1c. Thus, S2 has fulfilled the mathematical foundation indicator in question number 1. In the second indicator, plausibility, S2 can see the relationship between known things and the suitability between known and questioned information. S2 was also able to provide logical reasons related to the solution strategy used during the interview. Based on the final results obtained, the results were following the question. Thus, the S2 subject has fulfilled the plausibility indicator in question number 1.

In the third indicator, novelty, in contrast to S1, who divided the carton horizontally, S2 took a creative step to determine the length and width of the cuboid by dividing the carton vertically into four parts. Then, S2 applied the strategy to solve the problem. The methods used by S1 and S2 are both correct because problem number 1 is open-ended. It means that the answer can be obtained using more than one way. Thus, S2 can fulfill the novelty indicator. Based on the description of the student's answer to question number 2, S2 fulfills all indicators of creative mathematical reasoning. It means that S2 can perform creative mathematical reasoning well in this question. It aligns with Birkeland (2019) that people who can do creative mathematical reasoning fulfill three indicators:

mathematical foundation, plausibility, and novelty. The following is S2's answer to question number 2.

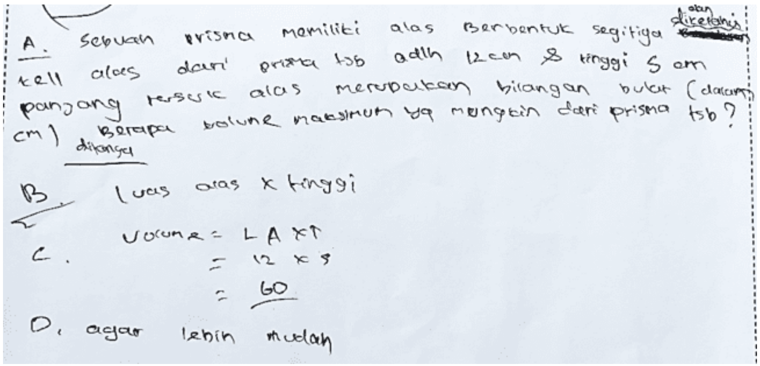
A. Sebuah prisma memiliki alas berbentuk segitiga dan diketahui
kell alas dari prisma tsb adlh 12 cm & tinggi 5 cm
panjang rusuk alas merupakan bilangan bulat (dalam
cm) Berapa volume maksimum yg mungkin dari prisma tsb?
ditanya
B. luas alas x tinggi
C. volume = LA x t
= 12 x 5
= 60
D. agar lebih mudah

Figure 6. Test Result of S2 on Question Number 2

Based on Figure 6, S2 can correctly write the known and asked information from the problem in question 1a. However, in giving and applying the solution steps, S2 forgot to determine the length of the sides of the prism's base. As a result, S2 immediately made the perimeter information the base area so that the prism's volume was obtained incorrectly. During the interview, S2 realized that the perimeter of the prism's base should be divided by three to determine the length of the sides. Just like S1, S2 misunderstood that what was asked in the question was not the prism's volume but the prism's maximum volume. It means that S2 has not been able to determine the complete solution strategy, so it is wrong to apply it. Thus, S2 has not met the mathematical foundation.

In the second indicator, namely plausibility, S2 has not been able to connect the information of the base's perimeter and the base's shape into the solution steps. S2 has not seen the suitability between the known and questioned information. As a result, S2 did not know what type of triangle was the prism's base. It means that S2 has not been able to provide logical reasons related to the solution strategy used. The answer given it is not following the question. Thus, S2 has not met the plausibility indicator. In the third indicator, namely novelty, S2 has not been able to provide elements of novelty in the solution steps. Thus, S2 has not met the novelty indicator. Based on the description of the student's answer to question number 2, S2 has not fulfilled all indicators of creative mathematical reasoning. It means that S2 cannot perform creative mathematical reasoning well in this question. Students who miss one component are considered not fulfilling the creative mathematical reasoning indicator (Kusaeri et al., 2021). The following is S2's answer to question number 3.

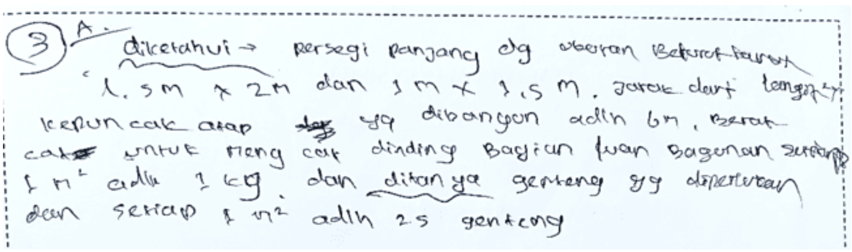
(3) A. diketahui → persegi panjang dg ukuran berturut-turut
1,5 m x 2 m dan 1 m x 1,5 m. jarak dari langit-langit
kepuncak atap yg dibangun adlh 6 m, berat
cat untuk mengecat dinding bagian luar bangunan setiap
1 m² adlh 1 kg. dan ditanya genteng yg diperlukan
dan setiap 1 m² adlh 25 genteng

Figure 7. Test Result of S2 on Question Number 3

Based on Figure 7, S2 can write some of the general information from the problem. There is missing information, namely the length of the side of the building = 16m. Furthermore, the information asked could be mentioned when interviewed. However, S2 admitted that he could not understand the problem. As a result, he could not write a solution strategy for problem number 3. It means that S2 has not been able to determine the relevant strategy to solve the problems, so S2 cannot write down the strategy to be applied. Thus, S2 has not fulfilled the mathematical foundation indicator. S2 could not fulfill the plausibility and novelty indicators because no answer was given. Meanwhile, for problem number 4, no answer was given, so the indicators of mathematical foundation, plausibility, and novelty could not be met. Based on the description of the student's answer to questions number 3 and 4, S2 has not fulfilled all indicators of creative mathematical reasoning. It means that S2 cannot perform creative mathematical reasoning in this question. Jonsson et al. (2022) state that students are unfamiliar with tasks that demand creative reasoning skills, disrupting their creative mathematical reasoning.

Overall, S2 has been able to do creative mathematical reasoning on one problem model. When faced with a different problem model and material, he has been unable to do creative mathematical reasoning. Kusaeri et al. (2021) explained that a person can do creative mathematical reasoning if he can master the indicators of creative mathematical reasoning. It means that S2 has been unable to do creative mathematical reasoning consistently. It can occur because S2 does not understand all the questions, especially about prisms, pyramids, and combined solid figures, has a poor understanding of the material, and is not used to working on similar problems. It is in line with the research result by Yuniar (2019) that students with moderate intrinsic cognitive load cannot solve problems properly consistently.

3) Subject S3

S3 worked on 3 of the four problems given but did not complete the answer to problem number 3 perfectly. The following is S3's answer to question number 1.

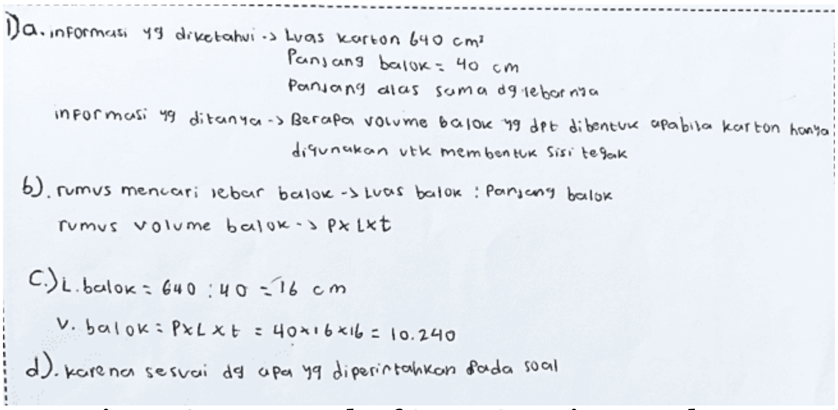
1)a. informasi yg diketahui -> Luas karton 640 cm²
Panjang balok = 40 cm
Panjang alas sama dg lebarnya
informasi yg ditanya -> Berapa volume balok yg dpt dibentuk apabila karton hanya digunakan utk membentuk sisi tegak
b). rumus mencari lebar balok -> Luas balok : Panjang balok
rumus volume balok -> p x L x t
c.) L. balok = 640 : 40 = 16 cm
V. balok = p x L x t = 40 x 16 x 16 = 10.240
d). karena sesuai dg apa yg diperintahkan pada soal

Figure 8. Test Result of S3 on Question Number 1

Based on Figure 8, S3 can correctly write the information asked in the question but has an error in identifying one of the available information. S3 wrote that 40 cm was the cuboid's length, not the rectangle's. When interviewed, S3 still gave the same answer. As a result, there was a misperception in determining the step of solving the problem, namely in determining the width of the carton. He inputted an incorrect size in determining the volume of the cuboid, so the final result was wrong. Thus, S3 has not fulfilled the indicator of mathematical foundation in question number 1.

In the second indicator, namely plausibility, S3 has not seen the relationship between the carton area, carton length, and cuboid volume. S3 also has not been able to provide logical reasons for the solution steps provided. As a result, S3 did not get the answer results following the task question. Thus, S3 has not fulfilled the plausibility indicator in problem number 2. In the third indicator, namely novelty, S3 has not been able to provide at least one novelty in the problem-solving steps. Thus, S3 has not fulfilled the novelty indicator in question number 2. Based on the description of the student's answer to question number 2, S3 has not fulfilled all indicators of creative mathematical reasoning. It can be concluded that S3 cannot do creative mathematical reasoning in solving this problem. It is in line with the research result by Yuniar (2019) that students with high intrinsic cognitive load struggle to understand and solve the problem. The following is S3's answer to question number 2.

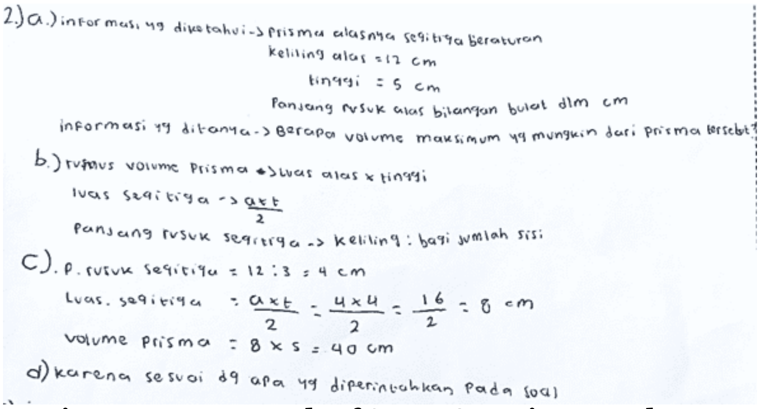

Figure 9. Test Result of S3 on Question Number 2

Based on Figure 9, S3 wrote the information known and asked about the prism ultimately. S3 can also determine the strategy that will be used to solve the problem, but S3 did not write the strategy in sequence. In question 2c, S3 supposes the prism's base is a triangle with all sides equal in length, but S3 did not mention in writing that the triangle is equilateral. There was a mistake when S3 applied the strategy. S3 did not determine the triangle's height before finding the triangle's area. As a result, there was a calculation error in determining the prism's volume. Meanwhile, S3 made the same mistake as S1 and S2 by assuming that the prism's volume was the same as the maximum in question 3. It means that S3 has not been able to apply the strategy in the problem-solving step. Thus, S3 has not fulfilled the mathematical foundation indicator in problem number 2.

In the second indicator, plausibility, S3 can see the relationship between the perimeter of the prism's base and the length of the side of the prism's base. However, S3 has not been able to see the relationship between the sides of the triangle obtained to determine the area of the triangle, which is the prism's base, so there is a mistake in determining the prism's volume. It means that S3 has been able to see the relationship between general information but is still wrong in adjusting between known and questioned information. When asked through the interview why the length of the triangle's side is 4 cm and why 4 cm is directly used as the base and height of the triangle, S3 has not given the right reason. However, S3 was convinced that the answer he had obtained was correct, even though the results were not following the question. Thus, S3 has not been able to fulfill the plausibility indicator in question number 2. In the third indicator, novelty, S3 has been unable to apply the new strategy he developed to solve the problem. Thus, S3 has not fulfilled the novelty indicator in question number 2. Based on the description of the student's answer to question number 2, S3 has not fulfilled all indicators of creative mathematical reasoning. It means that S3 cannot perform creative mathematical reasoning in this question. Kusaeri et al. (2021) explained that a person can do creative mathematical reasoning if he can master the indicators of creative mathematical reasoning. It means that S3 has been unable to do creative mathematical reasoning in this question. The following is S3's answer to question number 3.

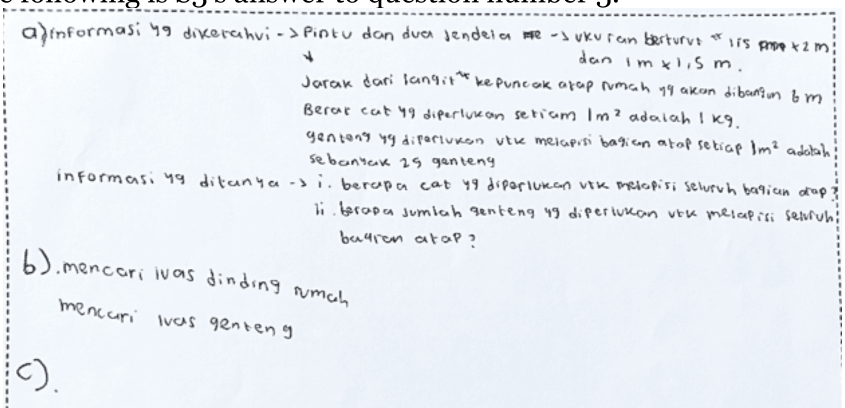

Figure 10. Test Result of S3 on Question Number 3

Based on Figure 10, S3 can ultimately write the information asked in the question about the combined solid figures. However, similar to S2, S3 ignored one of the available information from the problem: the height of the wall = 16 m. In question 2b, S3 can mention the steps that will be taken to solve the problem, but S3 has not been able to apply the strategy in the solution step. Through interviews, S3 explained that he was confused about what formula to use and how to apply the available information to the solution steps. Thus, S3 has not fulfilled the mathematical foundation indicator in question number 3. He also has not fulfilled the plausibility and novelty indicators because he did not provide answers to questions 2c and 2d. Furthermore, S3 did not work on question number 4 on the answer sheet, meaning that all indicators of creative mathematical reasoning were unmet.

Overall, S3 has been unable to do creative mathematical reasoning on the entire set of problems. In some questions, S3 can only explain the information known and asked from the problem. This component is part of the mathematical foundation indicator. However, S3 cannot be said to fulfill the mathematical foundation indicator because it does not fulfill all the components that must be mastered from this indicator. Kusaeri et al. (2021) explain that a person can fulfill the mathematical foundation indicator if he can explain the known information, write down the information asked, determine a strategy based on the intrinsic nature of mathematics that is relevant to what is known, and asked, and apply the strategy that has been chosen. It happened because S3 almost did not understand all the questions about flat and solid geometry given, had poor mastery of the material, and was not used to working on similar problems. Poor mastery of the material is known from S3's explanation that he does not know the right formula to answer the question correctly.

Based on the discussion above, S1 has a low intrinsic cognitive load. S1 tends to be able to understand flat and solid geometry material. Therefore, when given a series of tasks with different levels of material complexity, he can do well. S2 has a moderate intrinsic cognitive load. S2 only understands some subtopics in flat and solid geometry material, so S2 is sometimes still challenging to understand the problem with a reasonably high complexity level. S3 has a low intrinsic cognitive load. S3 almost did not understand the material of flat and solid geometry well. As a result, when faced with a series of tasks with high material complexity, S3 is challenging to understand how to solve the problem. Following the research results by Paas dan Sweller (2014), a person's intrinsic cognitive load will be high if the material is formed from interrelated elements to form complex bonds. Conversely, the intrinsic cognitive load will be low if the material is not too complicated.

4. CONCLUSION

Based on the study's results, it can be concluded that the higher the intrinsic cognitive load someone has, the lower their creative mathematical reasoning. Students with low intrinsic cognitive load can perform creative mathematical reasoning well and almost consistently, although the complexity of the material is different. Students with moderate intrinsic cognitive load can perform creative reasoning but are inconsistent. He can only do creative reasoning on material that has low complexity. At the same time, students with high intrinsic cognitive load cannot perform creative mathematical reasoning. In conducting further research, students' difficulties in performing creative mathematical reasoning should be analyzed along with the factors that cause it to occur so that teachers can provide appropriate learning strategies in the classroom.

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