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Characterization of Students' Misconceptions Based on Four Tier Diagnostic Test with Certainty of Response Index on Flat Sides 3-Dimensional Figures

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ABSTRACT

Misconceptions must be detected, one of which is by using the four-tier diagnostic test with certainty of response index. This research aims to examine students' misconceptions based on the confidence level of students' answers and reasons on flat sides 3-dimensional figures. This research is a multi-case study qualitative research. The research subjects consisted of twenty 8th-grade students who experienced misconceptions about the material of sides 3-dimensional figures. The instruments used in this research are the researcher, diagnostic test of flat-sided 3-dimensional figures, and interview guidelines. The data were the subject's written answers and the subject's interview recordings. The research data were analyzed using the classification rubric of the four-tier diagnostic test assessment results with the certainty of response index. The results of this study are the characteristics of four types of classificational misconceptions, four types of correlational misconceptions, and two types of theoretical misconceptions. This study concludes that misconceptions only occur in students who give wrong reasons with a high level of confidence.

Keywords**:** *misconceptions, flat sides 3-dimensional figure, four-tier diagnostic test, certainty of response index, junior high school students*

Karakterisasi Miskonsepsi Siswa Berdasarkan *Four Tier Diagnostic Test* dengan *Certainty of Response Index* pada Materi Bangun Ruang Sisi Datar

ABSTRACT

Miskonsepsi harus dideteksi, salah satunya dengan menggunakan instrumen *four tier diagnostic test* dengan *certainty of response index*. Penelitian ini bertujuan

untuk mengkaji miskonsepsi siswa berdasarkan tingkat keyakinan jawaban dan alasan siswa pada materi bangun ruang sisi datar. Penelitian ini merupakan penelitian kualitatif studi kasus jamak. Subjek penelitian terdiri dari dua puluh siswa kelas 8 yang mengalami miskonsepsi pada materi bangun ruang sisi datar. Instrumen penelitian ini adalah Peneliti, tes diagnostik materi bangun ruang sisi datar, dan pedoman wawancara. Data penelitian ini adalah jawaban tertulis subjek dan hasil rekaman wawancara. Data penelitian dianalisis menggunakan rubrik klasifikasi hasil penilaian *four tier diagnostic test* dengan *certainty of response index*. Hasil dari penelitian ini adalah karakteristik dari empat tipe miskonsepsi klasifikasional, empat tipe miskonsepsi korelasional, dan dua tipe miskonsepsi teoritikal. Kesimpulan penelitian ini adalah miskonsepsi hanya terjadi pada siswa yang memberikan alasan jawaban yang salah dengan tingkat keyakinan tinggi.

Keywords**:** *miskonsepsi, bangun ruang sisi datar, four tier diagnostic test, certainty of response index, siswa SMP*

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1. Introduction

Geometry is one of the important topics to learn and is used in learning other mathematics topics. However, geometry is still a difficult material for students (Anugrah & Pujiastuti, 2020; Ambarwati et al., 2020). Based on the published TIMSS 2011 score data, the average Indonesian score is below the international average in all domains, and in geometry, content has a low score of 24% correct answers (Mullis et al, 2012). The results of the TIMSS 2011 question analysis show that in geometry content only 25% of Indonesian students answered correctly in the reasoning cognitive domain and 0% for the application cognitive domain.

Junior high school geometry material contains several concepts, one of which is flat-sided geometric shapes. However, many students still make mistakes in solving flat-sided geometric shape problems (Ambarwati et al., 2020; Hasibuan, 2018; Shodikin et al., 2023; Kania & Ristiana, 2020). One of the causes of mistakes in working on flat-sided geometric shape problems is that students experience misconceptions. The results of research by Fajari (2020), Nurawwaluliza (2021), and Muchyidin, et al. (2020) show that many students still experience misconceptions about flat-sided geometric shapes and material (Fajari, 2020; Nurawwaluliza, 2021; Muchyidin et al., 2020).

Misconception is an understanding of a concept that does not conform to the knowledge of concepts that are generally accepted or that have been agreed upon by experts (Modell, 2005; Lubis & Wandini, 2023). Misconceptions can occur due to a person's error in understanding a concept that is built on their experience (Fuentes, 2021). Furthermore, mathematical misconceptions are wrong ideas that result from students' misunderstandings about mathematical concepts (Sukardi et al., 2023; Sukma & Masriyah, 2022; Shodikin, et al., 2019; Insani & Manoy, 2022). These wrong ideas are believed to be true by students so repeated and systematic errors occur (Safrina & Darmawan, 2016; Khusnah, et al., 2022; Ainiyah &

Sugiyono, 2016). If one concept is not understood properly, this will affect the understanding of the next related concept (Setyaningrum et al., 2018; Pratiwi et al, 2022; Dahlan & Kurniasari, 2022).

In the field of geometry, misconceptions can be divided into three types: classificational, correlational, and theoretical misconceptions. Classificational misconceptions are misconceptions about determining examples and non-examples. Correlational misconceptions are misconceptions about determining the relationship between one object and another. Theoretical misconceptions are misconceptions about applying formulas. Misconceptions must be detected immediately so as not to cause a chain of misconceptions about related concepts.

Student misconceptions can be identified in several ways, including diagnostic tests, interviews, concept mapping, and discussions (Gurel, 2015). The easiest way to detect misconceptions in mathematics is to use diagnostic tests (Mulyani, 2016). There are many diagnostic test designs to detect misconceptions, namely diagnostic tests, two-tier diagnostic tests, three-tier diagnostic tests, and four-tier diagnostic tests (Suwarto, 2013; Mulyani, 2016). The four-tier *diagnostic test* (FTDT) is a diagnostic test design developed from the three-level diagnostic test (Suwarto, 2013; Mulyani, 2016). This development was carried out due to the development of needs in the learning process and improvements to previous diagnostic tests (Gurel, 2015; Suwarto, 2013). As the name suggests, this test consists of four levels, the first level is in the form of descriptive questions, the second level measures students' confidence in the answers to the first level, the third level asks for reasons for the answers, and the fourth level measures students' confidence in the reasons for the answers. In FTDT itself measuring confidence at the second and fourth levels only uses the sure and not sure options, but it can be developed by using the certainty of response index (CRI) scale (Diani, 2019; Putri & Subekti, 2021). CRI is used by asking students to give a score on a scale (0-5) according to the student's confidence in their ability to determine the answer based on knowledge or concepts they already know (Setyaningrum et al., 2018; Puspitasari, 2022).

In the preliminary study, researchers found that there were still misconceptions about the material of flat-sided spatial figures. Here is one student's answer as evidence.

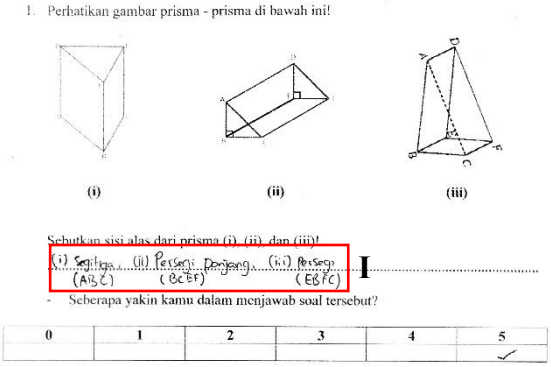

Figure 1. Student Answers

Figure 1 marked with I shows the misconceptions that occur in students related to determining the base side of a triangular prism. This is reinforced by the results of the interview, students stated that the base side of the prism is always at the bottom. Students are confident in the concept so they can answer spontaneously.

Based on results from studies introduction, it is important to do more in-depth study of junior high school students' misconceptions of the material of flat-sided spatial structures using FTDT with CRI. The following is presented position This research in Table 1

regarding a study previously which has carried out by several experts in the field of education mathematics.

Table 1. Research Position about Previous Research

Author (Year)	Subject	Focus Study	Results
Puspitasari (2018)	8th-grade students	Use of CRI to detect misconceptions students on spatial geometry material side flat and its relation with belief student	The use of CRI shows that students who answered incorrectly with belief tall including misconception However If belief is low lack of knowledge
Princess & Subekti (2021)	Grade 9 students	Measure misconception students use FTDT instrument with CRI	Use of FTDT with CRI *is* more effective compared to type tests and other diagnostics to detect misconception
Muchyidin, et al., (2020)	8th-grade students	Digging deeper misconception students on spatial geometry material	Still, many junior high school students experience misconceptions about spatial geometry material
Ardiansyah & Darmawan (2024)	8th-grade students	Review characteristics misconception students based on level belief student use FTDT instrument with CRI	Characteristics from four types of misconception classification, four types of misconception correlational, and two types of misconception theoretical

Based on Table 1, the research conducted by Puspitasari (2018) on 8th-grade junior high school students focused on CRI. and its relation to students' beliefs. The results of the study using CRI *showed* that students who answered incorrectly with high confidence included misconceptions, but if confidence was low, it was a lack of knowledge (Puspitasari, 2018). Meanwhile, research conducted by Putri & Subekti (2021) on 9th-grade students focused on measuring students' misconceptions using the FTDT instrument with CRI. The results of this study indicate that the use of FTDT with CRI *is* more effective than other types of diagnostic tests in detecting misconceptions [27] . Further research was conducted by Muchyidin et al. (2020) on 8th-grade junior high school students focusing on exploring students' misconceptions of spatial geometry material. The results of this study indicate that there are still many junior high school students who experience misconceptions about spatial geometry material (Muchyidin et al., 2020).

Furthermore, this study was conducted because there has been no previous research that examines junior high school students' misconceptions of flat-sided geometric shapes using the four-tier diagnostic test instrument with a certainty of response index and examines the characteristics of misconceptions that occur based on the level of confidence in answering and giving reasons. This study is important to conduct because misconceptions must be detected so that they can be addressed immediately according to student characteristics. If misconceptions can be detected early and the causes and relationships with students' confidence levels are known, teachers can choose models, choose learning methods, or

construct appropriate scaffolding in learning to reduce the level of misconceptions that occur in students.

2. Research Methods

2.1 Types of research

This research is qualitative research with a multiple case study type. Multiple case studies are a type of qualitative research that uses many issues or cases in one study (Stake, 2010). A case is a certain condition about people, events, places, or something actual, ongoing, not something that has passed. The case studied is the characteristics of misconceptions of several 8th-grade subjects on the material of flat-sided geometric shapes.

2.2 Research Subject

The subjects in this study were 8th-grade students of SMPN 3 Malang who had learning experience room side flats previously so that own sufficient knowledge about predetermined indicators. Determination The subjects in this study were based on an objective study so the subject of this research was chosen through the technique of snowball sampling (Darmawan & Yusuf, 2022). The first subject is selected in such a way that the desired data is produced, as well as the selection of the second subject and so on until saturated data is produced [30] . The subject selection process is carried out based on the following steps:

1. Students do test diagnostic four levels of description spatial structure material side flat.
2. The researcher analyzes the answers from students with rubric classification results evaluation four-tier diagnostic test with the certainty of response index.
3. Students interviewed related the answer to see How misconceptions happen.
4. Students who are indicated experience misconception chosen as subject study.
5. Students who do not indicate experience misconception No chosen as subject study.
6. The subject was selected several times until all over indicators set by researchers were fulfilled and produced saturated data.

2.3 Instrument Study

Instrument This research consists of on researcher, question sheet diagnostic test spatial structure material side flat, and interview guidelines. Use of question diagnostic test spatial structure material side flat as instrument This study aims to determine misconceptions that occur in students regarding spatial geometry material side flat. The questions given are 5 descriptive questions which are designed to cover all the indicators to be studied.

The diagnostic test questions used are the result of researchers' modifications of questions on flat-sided geometric shapes sourced from previous research by Fajari (2020) and Fitriani & Rohaeni (2020). Modifications to the questions were made so that the diagnostic test questions were in accordance with the four-tier diagnostic test design. Modifications were made by adding components to ask the reasons for students' answers and measure the level of student confidence. On the diagnostic test question sheet, to measure the level of student confidence in answering questions and providing reasons for answers using the CRI scale with a scale of 0 to 5. Here is the CRI format used in this study (Putri & Subekti, 2021).

0	1	2	3	4	5

Description: 0 = Guessing the Answer Randomly
1 = Very Unsure
2 = Not Sure
3 = Not Sure
4 = Sure
5 = Very Confident

Figure 2. Certainty of Response Index scale

Guidelines interview designed with adapt indicator understanding draft as an outline-questions that will be submitted to Subject. The type of interview in This research is semi-structured interview. Several questions were given that had been prepared by the researcher and would be developed spontaneously according to the student's answers. The purpose of this interview was to strengthen the analysis of the types of misconceptions experienced based on the opinions expressed by the subjects. More details are in Appendix 6.

2.4 Data and Data Analysis Techniques

Data from This research is answered by written subjects and interview recording results. Research data analysis techniques used are technique interactive data analysis according to Miles and Huberman, which consists of data collection, data reduction, data presentation, analysis results findings, as well as conclusion (Darmawan & Yusuf, 2022).

Data collection was carried out by giving question diagnostic tests of spatial structure side flat and Interviews to answer written students. The data that has been collected, and analyzed using classification rubric results from evaluation FTDT with CRI as follows [27] .

Table 2. Rubric for Classification of FTDT Assessment Results with CRI

Category	Answer	Level of Confidence in Answer	Reason	Reason Confidence Level
Misconception	Correct	CRI ≤ 3	Wrong	CRI ≥ 4
	Correct	CRI ≥ 4	Wrong	CRI ≥ 4
	Wrong	CRI ≤ 3	Wrong	CRI ≥ 4
	Wrong	CRI ≥ 4	Wrong	CRI ≥ 4

The focus of this research is the misconception subject so that the data used only indicates subject data experience misconceptions and inconsistent data required will reduced. After answers, students analyzed experiencing misconceptions and will do further analysis using indicator misconception geometry According to Fitriani & Rohaeni [29] . Types of misconceptions along with indicator misconceptions will investigated and presented in Table 3.

Table 3. Misconception Indicators

Types of misconceptions	Description	Indicator	No. Question
1. Classification Misconceptions	a. Misconceptions in determining the base side of a prism	a1. States that the base side of a triangular prism is always the bottom side plane (Fajari, 2020) (Nurawaluliza et al, 2021)	1
	b. Misconceptions in determining prism and non-prism	b1. States that cubes and blocks are not prisms (Luthfia, 2016)	2
		b2. Stating that the cylinder is a prism (Fitriani & Rohaeti, 2020)	
	c. Misconceptions in determining a pyramid and not a pyramid	c1. Stating that a cone is a pyramid (Fitriani & Rohaeti, 2020)	
	d. Misconceptions in determining the height of a triangular pyramid	d1. States that the height of a pyramid is always a vertical line segment (Fajari, 2020; Nurawaluliza et al, 2021)	3
		d2. States that the height of the pyramid does not have to be perpendicular to the base side (Fajari, 2020; Nurawaluliza et al, 2021)	
2. Correlational Misconception	e. Misconceptions in understanding the relationship between the volume formulas for cubes, cuboids, and prisms	e1. Stating that prisms, cubes, and cuboids are different shapes so their volume formulas are also different (Fitriani & Rohaeti, 2020)	4
3. Theoretical Misconceptions	f. Misconceptions in determining the surface area formula of a pyramid	f1. Using the pyramid volume formula to find the surface area of the pyramid (Luthfia, 2016; Muchyidin et al, 2020)	5
	g. Misconceptions in determining the volume formula of a pyramid	g1. Using the pyramid surface area formula to find the volume of the pyramid (Luthfia, 2016; Muchyidin et al, 2020)	
		g2. Using the prism volume formula to find the volume of a pyramid	

Then, the data is presented with the answer subject accompanied by reasons and results transcript Interview. Analysis results in findings study done through observation to answer written subjects and results interview. After doing an analysis, the Researcher's interesting conclusion related to misconceptions of junior high school students on spatial geometry material side flat.

3. Results and Discussion

3.1 Results

The results of the study on junior high school students' misconceptions of flat-sided spatial problems based on the FTDT assessment result classification rubric with CRI are presented in this section. The subjects consisted of twenty 8th-grade students. The subjects were chosen based on provisions that have been Researcher presented in section 2.2 of the article. The results presented include classificational, correlational, and theoretical misconceptions of the research subjects.

3.1.1 Classification Misconceptions

The classification misconceptions presented in this section are misconceptions in determining the height of a pyramid, determining the base side of a triangular prism, and determining prism- and pyramid-shaped objects. The data presented in this section are data generated by subjects and are divided into four types of classification misconceptions. Each type of classification misconception is presented with data generated by two subjects.

3.1.1.1 Type 1 Classification Misconceptions

Classification misconception type 1 is a classification misconception where the subject produces the correct answer with low confidence and gives reasons for the wrong answer with high confidence. The misconception that occurs in this type is a misconception in determining the height of the pyramid. Classification misconception type 1 Subject 1 (S1) and Subject 2 (S2) were studied through analysis of the subject's written answers and interview recording results as follows.

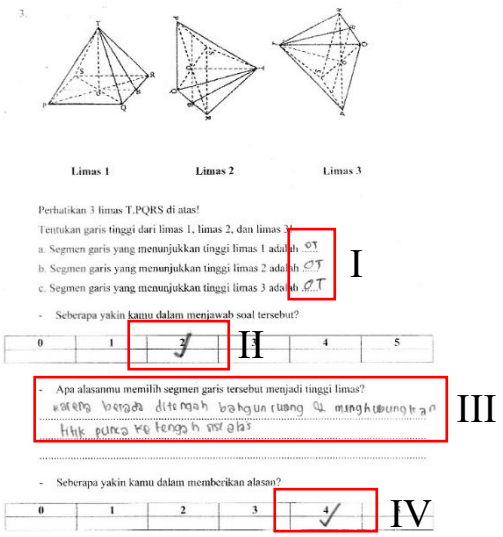

Figure 4. Answer S1

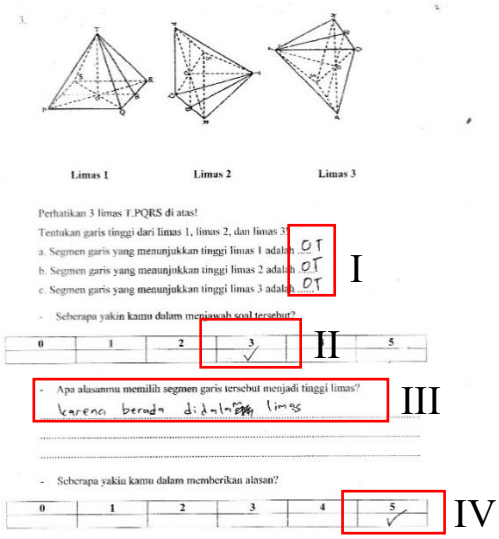

Figure 5. Answer S2

Figure 4 and Figure 5, marked I, show the answers of S1 and S2 in determining the height of the pyramid. It can be seen that the answers of S1 and S2 are correct that the line segments OT are the height lines of pyramids 1, 2, and 3. In Figure 4 and Figure 5, marked II, it is the level of confidence of S1 and S2 in answering the question. S1 and S2 ticked with a score < 4 indicating that S1 and S2 were not sure about their answers.

In Figure 4 and Figure 5, marked III, the reasons for S1 and S2's answers are shown. S1 gave the reason that the height of the pyramid is in the middle of the pyramid and connects the peak to the middle of the base of the pyramid. S2 gave the reason that the height of the pyramid is a line segment that is inside the pyramid. In Figure 4 and Figure 5, marked IV, the level of subject confidence in providing reasons. S1 and S2 ticked with a score ≥ 4 indicating that S1 and S2 were confident in their reasons. The researcher conducted a further investigation related to the misconceptions that occurred through Interview 2 and Interview 3 as follows.

Researcher: Why did you choose these line segments to be the height lines of pyramids 1, 2, and 3? *S1: because that* ***OT is in the middle of the geometric shape and connects the peak point to the middle of the base.*** *Researcher: Does the height line have to be perpendicular to the base of the pyramid?* *S1:* ***not necessarily, because the important thing is to connect the peak point to the center of the base*** *Researcher: Are you sure about your reasons?* *S1: sure, because that's how it is* *Researcher: So, which is the high line?* *S1 : [which OT should be]* *Researcher: Are you sure about your answer?* *S1 : [no]* *Researcher: Even though you are sure of your reasons, why are you not sure of your answer?* *S1 : [um..., I'm a bit confused seeing the pyramid being spun around so I'm not sure if it's OT]*	*Researcher: Why did you choose these line segments to be the height lines of pyramids 1, 2, and 3?* *S2: because,* ***it is inside the pyramid*** *Researcher: Does the height line have to be perpendicular to the base of the pyramid?* *S2:* ***no, the important thing is inside the pyramid*** *Researcher: Are you sure about your reasons?* *S2 : sure* *Researcher: So, which is the high line?* *S2: [um..., OT]* *Researcher: Are you sure about your answer?* *S2: [not really, that's why I filled in three]* *Researcher: Even though you are sure of your reasons, why are you not sure of your answer?* *S2: [I'm just doubtful, not sure whether my answer is correct or not]* *Researcher: Why do you hesitate?* *S2: [because I was confused looking at pyramids 2 and 3]*
Interview 2. S1 Misconception Search	**Interview 3.** S2 Misconception Exploration

The bold statements in Interview 2 and Interview 3 show S1 and S2's misconceptions in determining the height of the pyramid. The underlined statements in Interview 2 and Interview 3 show S1 and S2's spontaneity. S1 and S2 stated that the height of the pyramid does not have to be perpendicular to the base side spontaneously because they believe the concept is correct. Meanwhile, the statements marked with [ ] in Interview 2 and Interview 3 show S1 and S2's doubts in answering the questions. This doubt arises because the subjects are confused about whether the height remains the same OT if the pyramid is rotated.

3.1.1.2 Type 2 Classification Misconceptions

Classification misconception type 2 is a classification misconception where the subject produces the correct answer with high confidence and gives reasons for the wrong answer with high confidence. The misconception that occurs in this type is a misconception in determining the base side of a triangular prism. Classification misconception type 2 Subject 3 (S3) and Subject 4 (S4) were studied through analysis of the subject's written answers and interview recording results as follows.

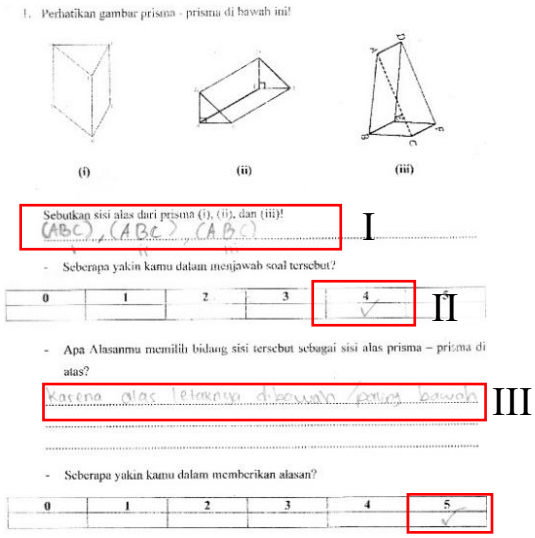

Figure 6. Answer S3

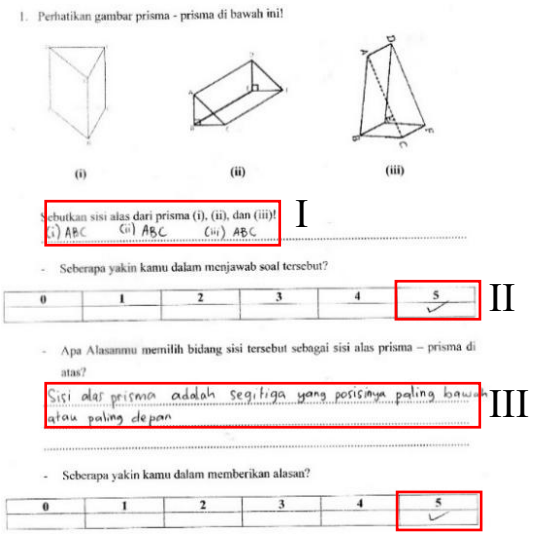

Figure 7. Answer S4

In Figure 6 and Figure 7 marked with I, it shows the answers of S3 and S4 in determining the base side of the triangular prism. S3 answered that the base sides of the prism (i), (ii), and (iii) are the side planes of ABC and EDF. While S4 answered that the base sides of the prism (i), (ii), and (iii) are the side planes of ABC. The answers of S3 and S4 are correct according to the concept of the base side of a triangular prism. In Figure 6 and Figure 7 marked with II are the levels of confidence of S3 and S4 in answering the questions. S3 and S4 ticked with a score ≥ 4 indicating that S3 and S4 were confident in their answers.

Figure 6 and Figure 7 marked III show the reasons for S3 and S4's answers. S3 gave the reason that the side plane is below. S4 gave the reason that the base side of the prism is a triangle that is positioned at the bottom of the front. Figure 6 and Figure 7 marked IV are the levels of confidence of S3 and S4 in providing reasons. S3 and S4 ticked with a score ≥ 4 indicating that S3 and S4 were confident in their reasons. The researcher conducted a further investigation related to the misconceptions that occurred through Interview 4 and Interview 5 as follows.

Researcher: Why did you choose these side planes to be the base sides of the triangular prisms (i), (ii), and (iii)? *S3: **because the base side is triangular and is at the bottom*** *Researcher: The base side must be the bottom side plane?* *S3: **That's right*** *Researcher: Then why did you also choose the EDF side plane as the base side?* *S3: My tutor said that the 2 sides of a triangle are the base sides.* *Researcher: But do you think your answer is correct?* *S3: Yes, that's right.*	*Researcher: Why did you choose these side planes to be the base sides of the triangular prisms (i), (ii), and (iii)?* *S4: As far as I know, the base of a triangular prism is the one that is shaped like a triangle.* *Researcher: Then why did you only choose side ABC, what about side DEF?* *S4: As far as I know, **the base of a triangular prism is like that, only the bottom or front triangle.*** *Researcher: Are you sure about that answer? That only the side plane ABC is the base side?* *S4: Sure, because that's the answer.*
Interview 4. Exploring S3 Misconceptions	**Interview 5.** S4 Misconception Exploration

The bold statements in Interview 4 and Interview 5 show S3 and S4's misconceptions in determining the base side of the prism. While the underlined statements in Interview 4 and Interview 5 show the spontaneity of S3 and S4. S3 and S4 stated that the base side of a triangular prism is a side plane that is triangular but only the one at the bottom or front position spontaneously because they were sure of their answers and reasons.

3.1.1.3 Classification Misconception Type 3

Classification misconception type 3 is a classification misconception where the subject produces a wrong answer with low confidence and gives a reason for the wrong answer with high confidence. The misconception that occurs in this section is a misconception in determining the base side of a triangular prism. Classification misconception type 3 Subject 5 (S5) and Subject 6 (S6) were studied through analysis of the subject's written answers and interview recording results as follows.

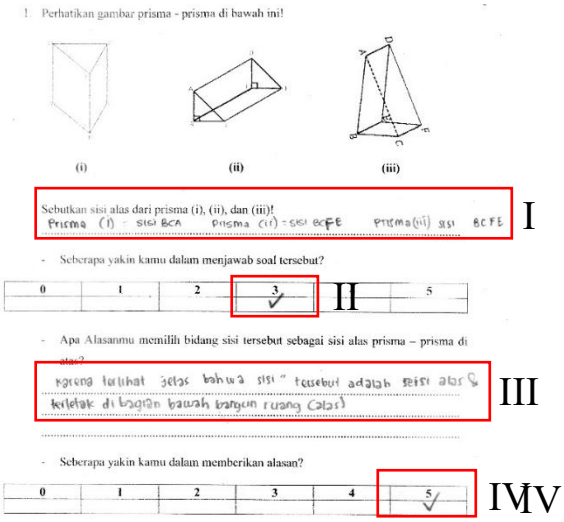

Figure 8. Answer S5

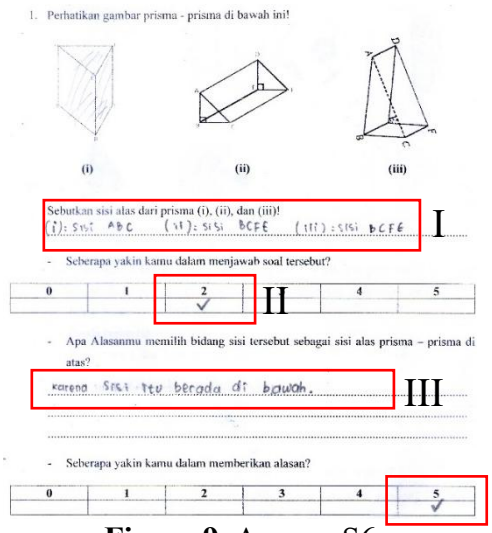

Figure 9. Answer S6

In Figure 8 and Figure 9, I show the misconception of S5 and S6 in determining the base side of the triangular prism. S5 and S6 answered that the base sides of the prism (ii) and (iii) are the side planes of BCEF. In Figure 8 and Figure 9 marked II is the level of confidence of S5 and S6 in answering the question. S5 and S6 ticked with a score < 4 indicating that S5 and S6 were not sure about their answer.

Figure 8 and Figure 9 marked III show the reasons for S5 and S6's answers. S5 and S6 gave the reason that the base side of the triangular prism is the side plane that is below. Figure 8 and Figure 9 marked IV are the levels of S5 and S6's confidence in providing reasons. S5 and S6 ticked with a score ≥ 4 indicating that S5 and S6 were confident in their reasons. The researcher conducted a further investigation related to the misconceptions that occurred through Interview 6 and Interview 7 as follows.

Researcher: Why did you choose these side planes to be the base sides of the triangular prisms (i), (ii), and (iii)?	*Researcher: Why did you choose these side planes to be the base sides of the triangular prisms (i), (ii), and (iii)?*
S5: ***<u>because the name is base, it must be below</u>***	*S6:* ***<u>because that side is below</u>***
Researcher: Is the base side definitely at the bottom?	*Researcher: Is the base side definitely at the bottom?*
S5: ***<u>Yes, definitely below.</u>***	*S6:* ***<u>Yes, that's right.</u>***

Researcher: Are you sure about your reasons? *S5: <u>sure</u>* *Researcher: If you are sure about your reasons, why are you not too sure about your answer?* *S5: [um..., I'm sure the reason is like that, the base is always at the bottom but I'm confused about which side is the bottom side for prism (ii)]*	*Researcher: Are you sure about your reasons?* *S6: <u>sure</u>* *Researcher: If you are sure about your reasons, why are you not too sure about your answer?* *S6: [I'm not too sure if those sides are the bottom sides]*
Interview 6. Misconception Exploration S5	**Interview 7.** Misconception Exploration S6

The bold statements in Interview 6 and Interview 7 show the misconceptions experienced by S5 and S6. The underlined statements in Interview 6 and Interview 7 show the spontaneity of S5 and S6. S5 and S6 stated that the base side of the triangular prism is the bottom side plane spontaneously because they believe the concept is correct. Meanwhile, the statements marked with [ ] in Interview 6 and Interview 7 show S5 and S6's doubts in answering the questions. S5 and S6 are not sure whether the base side is indeed the bottom side plane.

3.1.1.4 Classification Misconception Type 4

Classification misconception type 4 is a classification misconception where the subject produces a wrong answer with high confidence and gives a reason for the wrong answer with high confidence. The misconceptions that occur in this section are misconceptions in determining prisms and non-prisms and misconceptions in determining pyramids and non-pyramids. Classification misconception type 4 Subject 7 (S7) and Subject 8 (S8) were studied through analysis of the subject's written answers and interview recordings as follows.

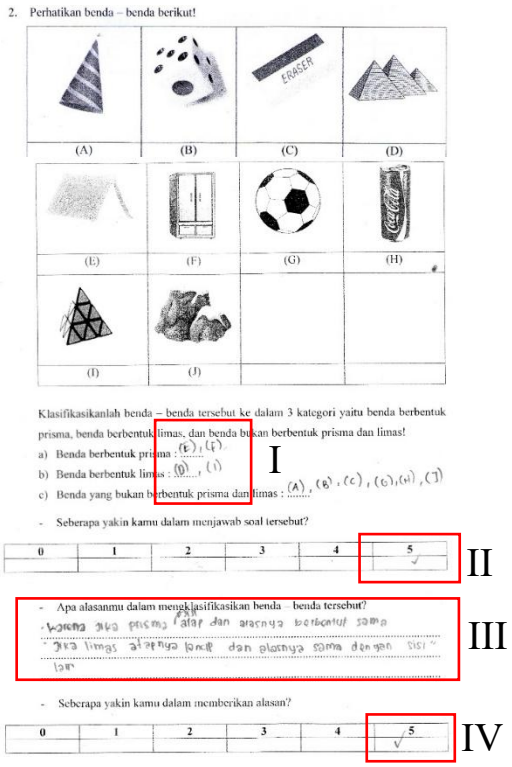

Figure 10. Answer S7

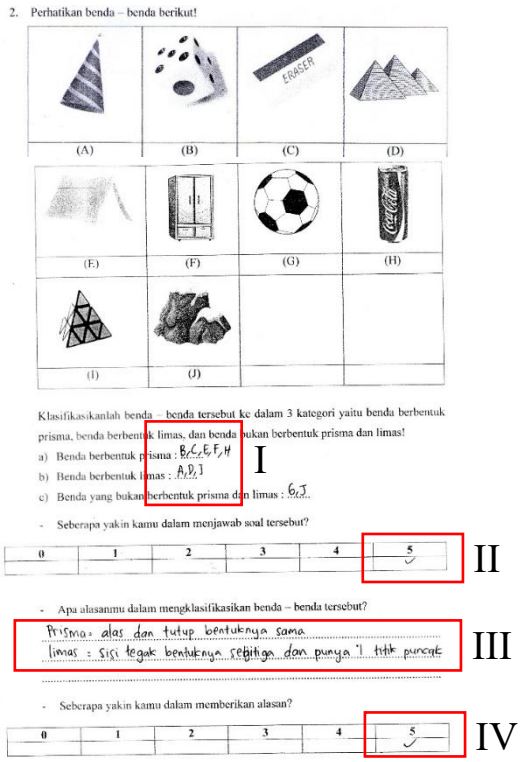

Figure 11. Answer S8

In Figure 10 and Figure 11 which are marked, I show the misconceptions of S7 and S8 in determining prism and not prism and determining pyramid and not pyramid. S7 stated that objects in the form of the prism are E and F. S7 considers cube and block not prism While S8 stated that objects in the form of the prism are B, C, E, F, and H, and objects in the form of a pyramid are A, D, I. S8 considers cylinder is a prism and cone is a pyramid. In Figure 10 and Figure 11 which are marked II are the level of confidence of S7 and S8 in answering the questions. S7 and S8 ticked with a score ≥ 4 indicating that S7 and S8 are sure of their answers.

Figure 10 and Figure 11 marked III show the reasons for S7 and S8's answers. S7 and S8 gave the reason that a prism is a geometric figure whose base and top sides are the same shape while a pyramid is a geometric figure that has 1 peak point. In Figure 10 and Figure 11 marked IV is the level of confidence S7 and S8 gave the reasons. S7 and S8 ticked with a score ≥ 4 indicating that S7 and S8 were sure of their reasons. The researcher conducted a further investigation related to the misconceptions that occurred through Interview 8 and Interview 9 as follows.

Researcher: In your opinion, what kind of spatial structure is a prism? *S7: The prism has the same shape as the roof and base.* *Researcher: Objects B, C, and H also have the same base and lid, but why did you only choose E and F?* *S7: **B is a cube, C is a block, H is a cylinder, not a prism.*** *Researcher: In your opinion, what kind of spatial structure is a pyramid?* *S7: The pyramid has a pointed roof.* *Researcher: Are you sure your answer and your reasons are correct?* *S7: Sure, because I think that's true.*	*Researcher: In your opinion, what kind of spatial structure is a prism?* *S8: the base and lid are the same* *Researcher: Does that mean it is object H?* *S8: **Yes, the base and lid are both circles.*** *Researcher: In your opinion, what kind of spatial structure is a pyramid?* *S8: the vertical sides of a triangle continue to have 1 vertex* *Researcher: Does that mean object A is also a pyramid?* *S8: Yes, **it is a pyramid because it has 1 peak.*** *Researcher: Are you sure your answer and your reasons are correct?* *S8: yes i am sure*
Interview 8. Misconception Exploration S7	**Interview 9.** Misconception Exploration S8

The bold statements in Interview 8 and Interview 9 show the misconceptions experienced by S7 and S8. The underlined statements in Interview 8 and Interview 9 show the spontaneity of S7 and S8. S7 stated that cubes and blocks are not prisms. While S8 stated that cylinders are prisms and cones are pyramids. S7 and S8 were able to answer spontaneously because they were sure that the concept was correct.

3.1.2 Correlational Misconceptions

Correlational misconception is a misconception in determining the relationship between one object and another. The data presented in this section is data generated by the subject and is divided into four types of correlational misconception. Each type of correlational misconception is presented with data generated by the subject.

3.1.2.1 Correlational Misconception Type 1

Correlational misconception type 1 is a correlational misconception where the subject produces the correct answer with low confidence and gives reasons for the wrong answer with high confidence. The misconception that occurs in this section is a misconception in

understanding the relationship between the volume formulas of cubes, cuboids, and prisms. Correlational misconception type 1 of Subject 9 (S9) and Subject 10 (S10) was studied through analysis of the subject's written answers and interview recordings as follows.

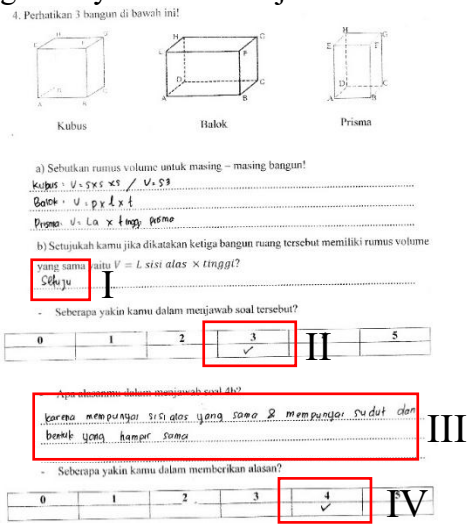

Figure 12 Answer S9

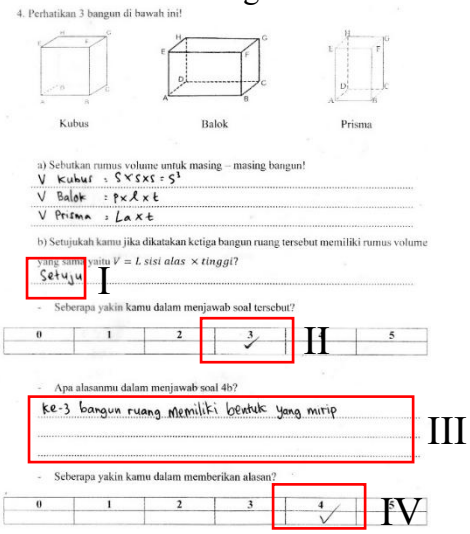

Figure 13 Answer S10

In Figure 12 and Figure 13 marked I shows the answers of S9 and S10 who agree that the volume of a cube, cuboid, and prism can use the formula $V = L\ alas \times tinggi$. S9 and S10 answered correctly in stating the formula for the volume of a cube, cuboid, and prism. In Figure 12 and Figure 13 marked II is the level of confidence of S9 and S10 in answering the question. S9 and S10 ticked with a score < 4 indicating that S9 and S10 were not sure about their answer.

Figure 12 and Figure 13 marked III shows the reasons for S9 and S10's answers. S9 and S10 gave reasons that cubes, blocks, and prisms can use the formula because they have similar shapes. In Figure 12 and Figure 13 marked IV is the level of confidence of S9 and S10 in giving reasons. S9 and S10 ticked with a score ≥ 4 indicating that S9 and S10 were confident in their reasons. The researcher conducted a further investigation related to the misconceptions that occurred through Interview 10 and Interview 11 as follows.

Researcher: Why do you agree that these three structures can use the formula for the volume of the base area times the height?	*Researcher: Researcher: Why do you agree that these three structures can use the formula for the volume of the area of the base multiplied by the height?*
*S9: **If you look at the shape of the three shapes, they are almost the same, the shape of the base is also the same.***	*S10: **because the shape is similar, the same volume formula can be used.***
Researcher: So, because the three geometric shapes are almost the same, isn't it because the three geometric shapes are prisms?	*Researcher: So, because the three geometric shapes are almost the same, isn't it because the three geometric shapes are prisms?*
*S9: **Yes, because cubes and blocks are not prisms, only their shapes are almost the same.***	*S10: **yes, cubes and cuboids are not prisms.***
Researcher: Why are you not sure about your answer that agrees that the three shapes can use the same formula?	*Researcher: Why are you not sure about your answer that agrees that the three shapes can use the same formula?*
S9: [I'm not sure if a cube can also use this formula because all the side lengths	*S9 : [I'm not too sure about the cube itself because it doesn't have a height]*
	Researcher: Are you sure about your reasons?
	S10: sure

are the same] *Researcher: But are you sure about your reasons?* *S9: Sure, because it seems like that.*	
Interview 10 S9 Misconception Search	**Interview 11** S10 Misconception Search

The bold statements in Interview 10 and Interview 11 show the misconceptions experienced by S9 and S10. The underlined statements in Interview 10 and Interview 11 show the spontaneity of S9 and S10. S9 and S10 stated that cubes, cuboids, and prisms can use the formula $V = L\ alas \times tinggi$ because they have similar shapes. Both S9 and S10 also stated that cubes and cuboids are not prisms, only their shapes are similar spontaneously because they believe the concept is correct. The statements marked with [ ] show S9 and S10's doubts in answering the question. S9 is not sure whether cubes can use the formula because the edges of a cube have the same length. While S10 is not sure whether cubes can use the formula because he thinks cubes have no height.

3.1.2.2 Correlational Misconception Type 2

Correlational misconception type 2 is a correlational misconception where the subject produces the correct answer with high confidence and gives reasons for the wrong answer with high confidence. The misconception that occurs in this section is the misconception in determining the relationship between the volume formulas of cubes, cuboids, and prisms. Correlational misconception type 2 of Subject 11 (S11) and Subject 12 (S12) was studied through analysis of the subject's written answers and interview recordings as follows.

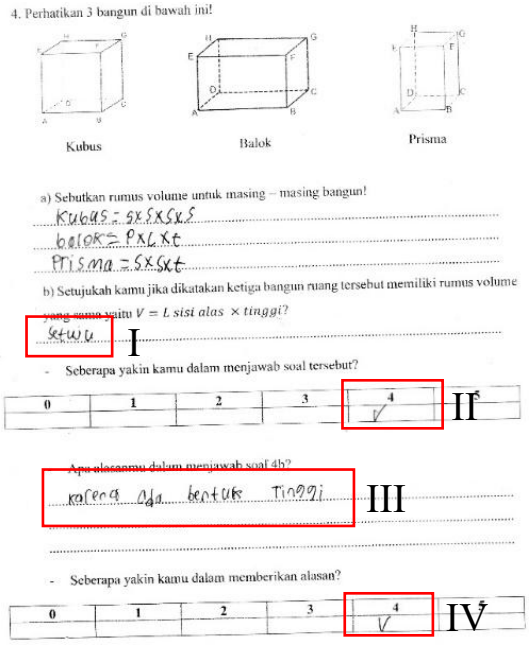

Figure 14. Answer S11

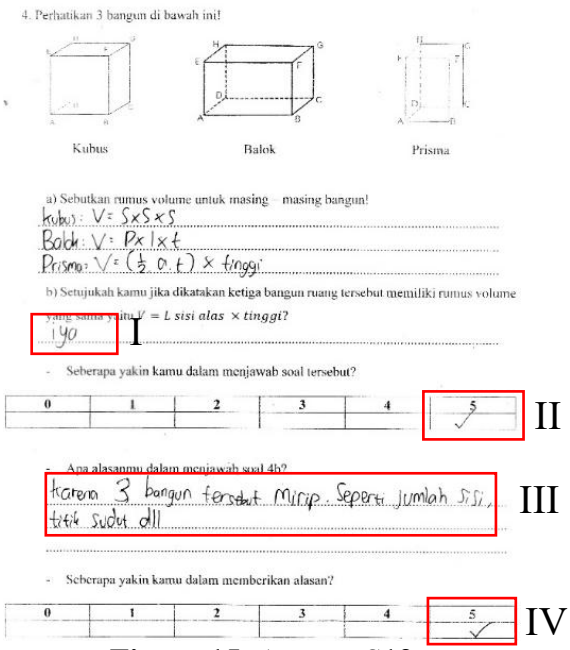

Figure 15. Answer S12

Figure 14 and Figure15, marked I, show the answers of S11 and S12 who agree that cubes, cuboids, and prisms can use the formula $V = L\ alas \times tinggi$. S11 and S12 answered correctly in stating the formula for the volume of cubes, cuboids, and prisms. Figure 14 and Figure 15, marked II, show the level of confidence of S11 and S12 in answering the question.

S11 and S12 ticked with a score ≥ 4 indicating that S11 and S12 were confident in their answers.

Figure 14 and Figure 15 marked III shows the reasons for S11 and S12's answers. S11 and S12 provide reasons that cubes, cuboids, and prisms have similarities such as having the same height, having the same number of sides and vertices. In Figure 14 and Figure 15 marked IV is the level of confidence of S11 and S12 in providing reasons. S11 and S12 ticked with a score ≥ 4 indicating that S11 and S12 were confident in their reasons. The researcher conducted a further investigation related to the misconceptions that occurred through Interview 12 and Interview 13 as follows.

Researcher: Why do you agree that these three structures can use the formula for the volume of the base area times the height? *S11: because they both have the same height* *Researcher: What do you mean?* *S11:* ***Cubes, cuboids, and prisms all have height so you can use this formula.*** *Researcher: Can we use this formula because they all have the same height or because the three geometric shapes are prisms?* *S11:* ***Yes, because they both have the same height, not because they are prisms because cubes and blocks are not prisms.*** *Researcher: Are you sure that your answers and reasons are correct?* *S11: Sure, that's right.*	*Researcher: Why do you agree that these three structures can use the formula for the volume of the base area times the height?* *S12:* ***because it has a similar shape*** *Researcher: What does a similar shape look like?* *S12: the number of sides and the number of corner points are the same* *Researcher: Can we use this formula because the three geometric shapes are similar or because the three geometric shapes are prisms?* *S12:* ***only similar because cubes and cuboids are not prisms*** *Researcher: Are you sure your answer and reasons are correct?* *S12: sure, it's true*
Interview 12. S11 Misconception Search	**Interview 13.** S12 Misconception Search

The bold statements in Interview 12 and Interview 13 show the misconceptions experienced by S11 and S12. While the underlined statements show the spontaneity of S11 and S12. S11 and S12 stated that there are similarities between cubes, blocks, and prisms, namely they have the same height, the same number of sides, and the same number of corner points. Although cubes, blocks, and prisms have these similarities, S11 and S12 stated that cubes and blocks are not prisms and not because of this they can use the formula $V = L\ alas \times tinggi$spontaneously because they believe the concept is correct.

3.1.2.3 Correlational Misconception Type 3

Correlational misconception type 3 is a correlational misconception where the subject produces a wrong answer with low confidence and gives a reason for the wrong answer with high confidence. The misconception that occurs in this section is a misconception in determining the relationship between the volume formulas of cubes, cuboids, and prisms. Correlational misconception type 3 Subject 13 (S13) and Subject 14 (S14) were studied through analysis of the subject's written answers and interview recording results as follows.

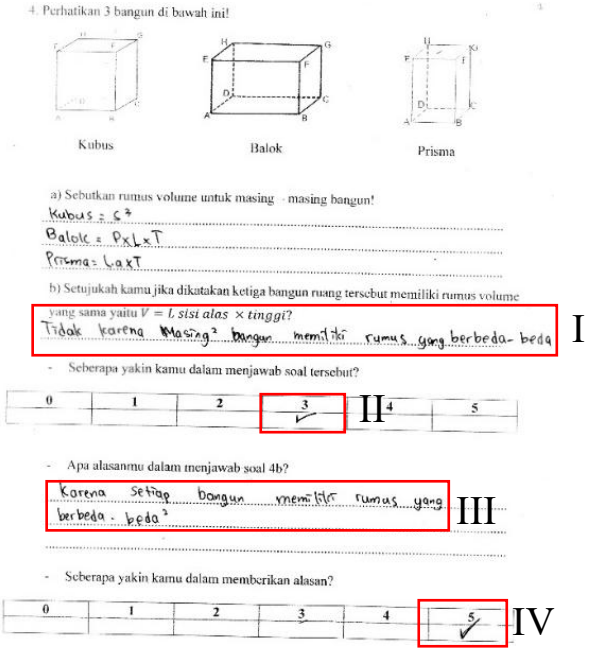

Figure 16. Answer S13

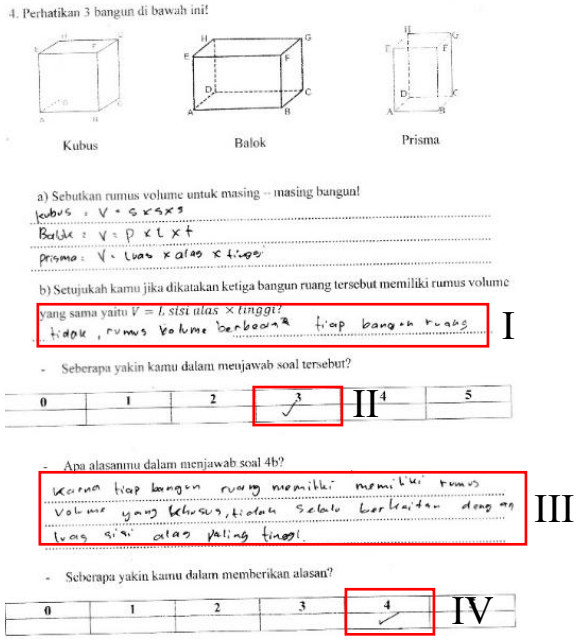

Figure 17. Answer S14

In Figure 16 and Figure 17 marked I show the misconception of S13 and S14 in determining the relationship between the volume formulas of cubes, cuboids, and prisms. S13 and S14 answered disagree that cubes, cuboids, and prisms can use the formula $V = L\ alas \times tinggi$. In Figure 16 and Figure 17 marked II is the level of confidence of S13 and S14 in answering the question. S13 and S14 ticked with a score < 4 indicating that S13 and S14 were not sure about their answer.

Figure 16 and Figure 17 marked III shows the reasons for S13 and S14's answers. S13 and S14 gave reasons that cubes, cuboids, and prisms are different geometric shapes so their volume formulas are also different. In Figure 16 and Figure 17 marked IV is the level of confidence of S13 and S14 in giving reasons. S13 and S14 ticked with a score ≥ 4 indicating that S13 and S14 were sure of their reasons. The researcher conducted a further investigation related to the misconceptions that occurred through Interview 14 and Interview 15 as follows.

Researcher: Why do you not agree that these three structures can use the formula for the volume of the base area times the height?	*Researcher: Why do you not agree that these three structures can use the formula for the volume of the base area times the height?*
S13: ***because each shape has a different volume formula***	*S14:* ***because the volume formula for each shape is different, it does not have to be the area of the base multiplied by the height.***
Researcher: Can only prisms use the formula for the volume of the base area times the height?	*Researcher: Can only prisms use the formula for the volume of the base area times the height?*
S13: ***yes, that's right, just a prism***	*S14:* ***Yes, only prisms can use this formula.***
Researcher: Are you sure that's true?	*Researcher: Are you sure that's really true?*
S13: Yes, that's right.	*S14: yes I'm sure*
Researcher: If you are sure that the reason is correct like that, why are you not too sure about your answer that disagrees?	*Researcher: If you are sure that the reason is correct like that, why are you not too sure about your answer that disagrees?*
S13 : [I doubt it because blocks and prisms are similar, blocks are lying	

down, and prisms are standing, so I'm not sure if we can use the same volume formula]	*S14 : [because blocks and prisms are similar, I doubt whether blocks can also use this formula or not]*
Interview 14. S13 Misconception Search	**Interview 15.** S14 Misconception Search

The bold statements in Interview 14 and Interview 15 show the misconceptions experienced by S13 and S14. Meanwhile, the underlined statements in Interview 14 and Interview 15 show the spontaneity of S13 and S14. S13 and S14 stated that cubes, cuboids, and prisms are different geometric shapes so that their volume formulas are also different and cannot use the formula $V = L\,alas \times tinggi$. S13 and S14 stated that the formula $= L\,alas \times tinggi$can only be used to find the volume of a prism spontaneously because S13 and S14 are sure that the concept is correct. The statements marked with [ ] in Interview 14 and Interview 15 show the subjects' doubts in answering the questions. S13 and S14 are not sure in answering the questions because they think that cuboids and prisms have similar shapes so that there is a possibility of using the formula $V = L\,alas \times tinggi$.

3.1.2.4 Correlational Misconception Type 4

Correlational misconception type 4 is a correlational misconception where the subject produces a wrong answer with high confidence and gives a reason for the wrong answer with high confidence. The misconception that occurs in this section is a misconception in the relationship between the volume formulas of cubes, cuboids, and prisms. Correlational misconception type 4 of Subject 15 (S15) and Subject 16 (S16) was studied through analysis of the subject's written answers and interview recordings as follows.

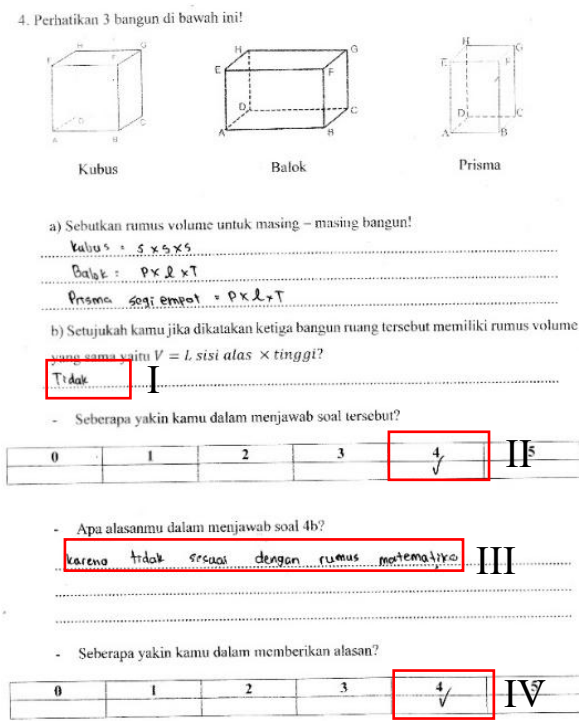

Figure 18. Answer S15

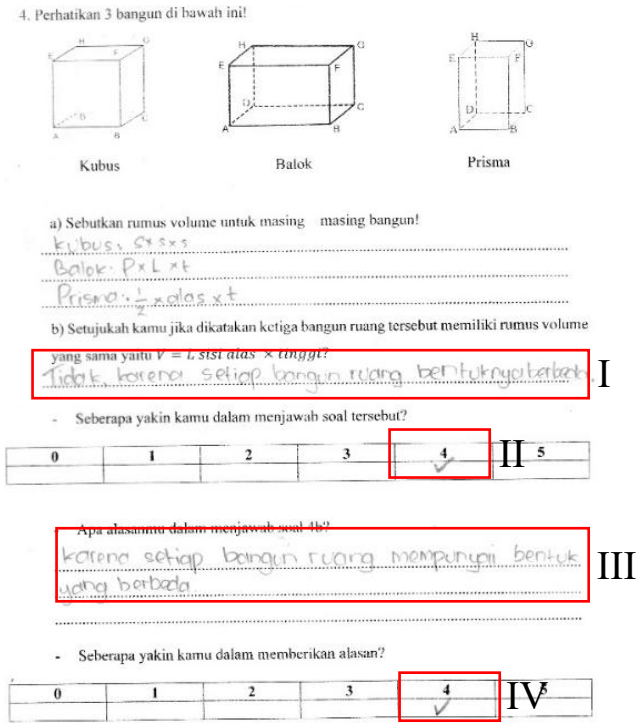

Figure 19. Answer S16

In Figure 18 and Figure 19 marked I shows the misconception of S15 and S16 in determining the relationship between the volume formulas of cubes, cuboids, and prisms. S15 and S16 answered disagree that cubes, cuboids, and prisms can use the formula $V = L\,alas \times$

$tinggi$. In Figure 18 and Figure 19 marked II is the level of confidence of S15 and S16 in answering the question. S5 and S6 ticked with a score ≥ 4 iindicating that S15 and S16 were confident in their answers.

Figure 8 and Figure 9 marked III show the reasons for S15 and S16's answers. S15 gave the reason that the formula $V = L\,alas \times tinggi$ does not match the mathematical formula. While S16 gave the reason that each geometric shape has a different shape. Figure 8 and Figure 9 marked IV are the levels of confidence of S15 and S16 in providing reasons. S15 and S16 ticked with a score ≥ 4indicating that S15 and S16 were confident in their reasons. The researcher conducted a further investigation related to the misconceptions that occurred through Interview 16 and Interview 17 as follows.

Researcher: Why do you not agree that these three structures can use the formula for the volume of the base area times the height? *S15:* ***because it does not comply with the mathematical formula*** *Researcher: What do you mean?* *S15: for a cube, the formula is s times s times s, for a cuboid, the formula is length times width times height, for a prism, the formula depends on whether it is a triangular or rectangular prism.* *Researcher: So you mean that cubes, blocks, and prisms are different geometric shapes so you can't use the formula for volume by multiplying the area of the base by the height, right?* *S15:* ***Yes, because if you use that formula the result will be wrong.*** *Researcher: Are you sure about your answer and reasons?* *S15: Yes, I'm sure because it has to follow the existing mathematical formula.*	*Researcher: Why do you not agree that these three structures can use the formula for the volume of the base area times the height?* *S16:* ***because cubes, cuboids and prisms are different geometric shapes*** *Researcher: So if it is different, you can't use the same formula, namely the formula for the volume of the area of the base multiplied by the height, right?* *S16:* ***can't*** *Researcher: The formula for the volume of the base area multiplied by the height can be used for what geometric shapes?* *S16: don't know* *Researcher: Then what is the formula for the volume of a prism?* *S16:* ***half the base times the height*** *Researcher: Isn't that the formula for the area of a triangle?* *S16:* ***can also be used to find the volume formula for a prism*** *Researcher: Are you sure about your answer and reasons?* *S16 : sure*
Interview 16. S15 Misconception Search	**Interview 17.** S16 Misconception Search

The bold statements in Interview 16 and Interview 17 show the misconceptions experienced by S15 and S16. Meanwhile, the underlined statements in Interview 14 and Interview 15 show the spontaneity of S15 and S16. S15 and S16 stated that cubes, blocks, and prisms are different geometric shapes so they cannot use the formula $V = L\,alas \times tinggi$ spontaneously because they are sure that the concept is correct. S15 added that if they use the formula $V = L\,alas \times tinggi$, the result will be wrong because it does not match the mathematical formula.

3.1.3 Theoretical Misconceptions

Theoretical misconception is a misconception in applying formulas. The data presented in this section is data generated by subjects and is divided into two types of theoretical

misconceptions. Each type of theoretical misconception is presented with data generated by 2 subjects.

3.1.3.1 Type 1 Theoretical Misconceptions

Type 1 theoretical misconception is a theoretical misconception where the subject produces a wrong answer with low confidence and gives a reason for the wrong answer with high confidence. The misconception that occurs in this type is a misconception in determining the formula for the volume and surface area of a pyramid. Type 1 theoretical misconceptions of Subject 17 (S17) and Subject 18 (S18) were studied through analysis of the subject's written answers and interview recordings as follows.

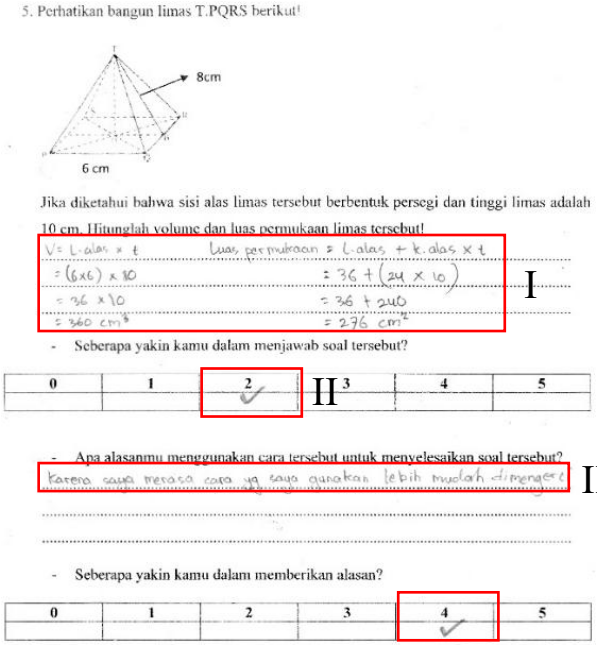

Figure 20. Answer S17

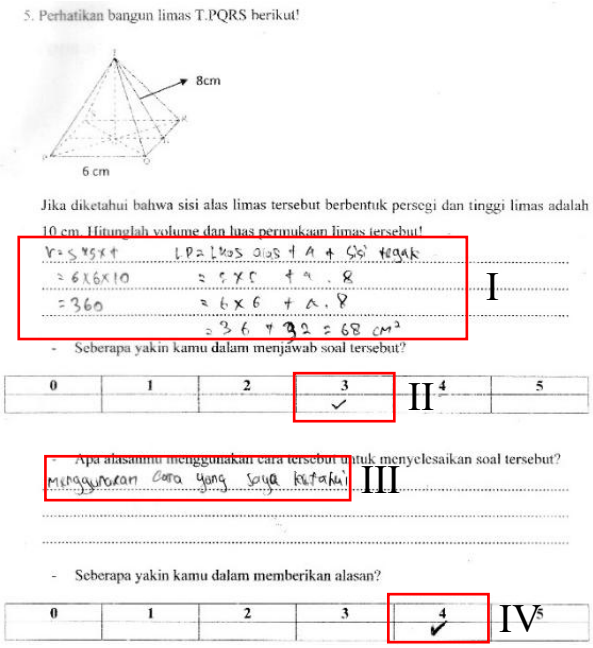

Figure 21. Answer S18

Figure 20 and Figure 21 marked with I show S17 and S18's misconception in determining the formula for the volume and surface area of a pyramid. S17 and S18 calculate the volume of a pyramid using the prism volume formula. S17 and S18 also use the wrong formula to find the surface area of a pyramid. Figure 20 and Figure 21 marked with II are the levels of confidence of S17 and S18 in answering the questions. S17 and S18 tick with a score < 4 indicating that S17 and S18 are not sure about their answers.

In Figure 20 and Figure 21 marked III shows the reasons for S17 and S18's answers. S17 and S18 provide reasons that this is indeed the formula for finding the volume and surface area of a prism. In Figure 20 and Figure 21 marked IV is the level of confidence of S17 and S18 in providing reasons. S17 and S18 ticked with a score ≥ 4 indicating that S17 and S18 were confident in their reasons. The researcher conducted a further investigation related to the misconceptions that occurred through Interview 18 and Interview 19 as follows.

Researcher: Why do you use this formula to calculate the volume of a pyramid? *S17: because that's the formula* *Researcher: Isn't that the formula for the volume of a prism?*	*Researcher: Why do you use this formula to calculate the volume of a pyramid?* *S18: therefore the formula for the volume of a prism* *Researcher: Isn't that the formula for the*

S17: ***As far as I know, that's the formula for the volume of a pyramid.*** *Researcher: Then why do you use this formula to calculate the surface area of the pyramid?* *S17:* ***As far as I know, it's like that, you look for the area of the base and then add the circumference of the base times the height of the pyramid.*** *Researcher: Why are you sure the formula is correct like that but you doubt your answer?* *S17: [because I'm not sure whether my calculations are correct or not]*	*volume of a prism?* *S18:* ***can also be used to calculate the volume of pyramids*** *Researcher: Then why do you use this formula to calculate the surface area of the pyramid?* *S18: That's the formula* *Researcher: What is the formula for the surface area of a pyramid?* *S18:* ***base area plus four times the vertical side*** *Researcher: Why are you sure the formula is correct like that but you doubt your answer?* *S18: [I am not confident in calculating]*
Interview 18. Misconception Search S17	**Interview 19.** S18 Misconception Search

The bold statements in Interview 18 and Interview 19 show the misconceptions experienced by S17 and S18. Meanwhile, the underlined statements in Interview 18 and Interview 19 show the spontaneity of S17 and S18. S17 and S18 stated that to find the volume of a pyramid, they can use the prism volume formula spontaneously because they are sure that the concept is correct. The statements marked with [ ] show S17 and S18's doubts in answering the questions. S17 and S18 are not sure to answer because they are unsure whether their calculations are correct or not.

3.1.3.2 Type 2 Theoretical Misconceptions

Type 2 theoretical misconception is a theoretical misconception where the subject produces a wrong answer with high confidence and gives a reason for the wrong answer with high confidence. The misconception that occurs in this section is a misconception in determining the height of the pyramid. Type 2 theoretical misconceptions of Subject 19 (S19) and Subject 20 (S20) were studied through analysis of the subject's written answers and interview recordings as follows.

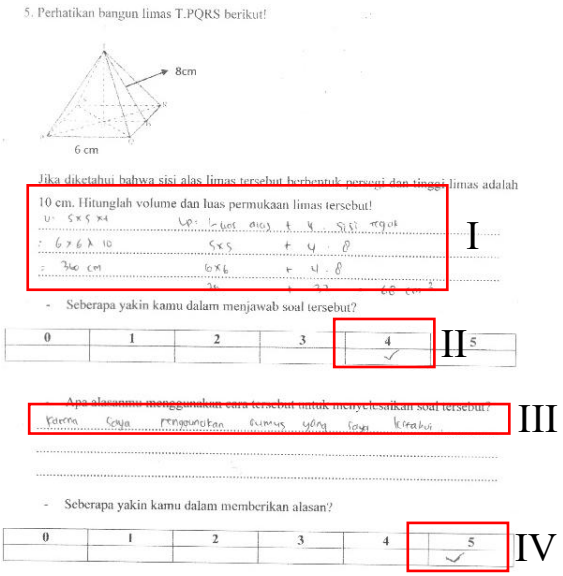

Figure 22. Answer S19

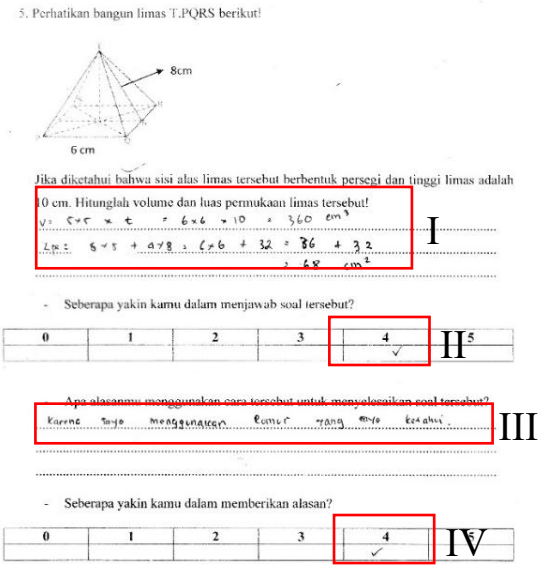

Figure 23. Answer S20

Figure 22 and Figure 23 marked with I show S19 and S20's misconception in determining the volume and surface area formulas of pyramids. S19 and S20 use the prism volume formula to calculate the volume of the pyramid and use the wrong formula to calculate the surface area of the pyramid. Figure 22 and Figure 23 marked with II are the levels of confidence of S19 and S20 in answering the questions. S19 and S20 tick with a score ≥ 4 indicating that S19 and S20 are confident in their answers.

Figure 22 and Figure 23 marked III show the reasons for S19 and S20's answers. S19 and S20 provide reasons that this is indeed the formula for finding the volume and surface area of a prism. Figure 22 and Figure 23 marked IV are the levels of confidence of S19 and S20 in providing reasons. S19 and S20 ticked with a score ≥ 4 indicating that S19 and S20 were confident in their reasons. The researcher conducted further investigation related to type 2 theoretical misconceptions that occurred through Interview 20 and Interview 21 as follows.

Researcher: Why do you use this formula to calculate the volume and surface area of the pyramid? *S19: because that's the formula* *Researcher: Isn't the volume formula you used the volume formula for a prism?* *S19:* ***Really? That's true as far as I know*** *Researcher: Then, is the surface area formula you used correctly?* *S19: I think so* *Researcher: Are you sure that's the formula for calculating the volume and surface area of a pyramid?* *S19: Yes, I'm sure it's correct.*	*Researcher: Why do you use this formula to calculate the volume and surface area of the pyramid?* *S20: I use the formula that I know* *Researcher: But isn't that the prism volume formula that you used to calculate the volume of the pyramid?* *S20:* ***No, that's the correct formula for the volume of a pyramid.*** *Researcher: Is the surface area formula for the pyramid you used correctly?* *S20:* ***yes, that's right*** *Researcher: Are you sure that's the formula for calculating the volume and surface area of a pyramid?* *S20 : sure*
Interview 20. S19 Misconception Search	**Interview 21.** S20 Misconception Search

The bold statements in Interview 20 and Interview 21 show the misconceptions experienced by S19 and S20. Meanwhile, the underlined statements in Interview 20 and Interview 21 show the spontaneity of S19 and S20. S19 and S20 answered spontaneously because they were sure that the concept of applying the volume and surface area formulas of the pyramid was correct.

3.2 Discussion

Classification misconception is a misconception in determining examples and non-examples (Ainiyah & Sugiyono, 2016; Fuat et al., 2020; Fadhilah et al., 2019). In type 1 classification misconception, subjects were found to produce correct answers with a low level of confidence and provide incorrect reasons with high confidence in determining the height of the pyramid. The subject's answer was correct, namely that the line segment $\overline{OT}$ is the height of the pyramid even though it was written incorrectly. This is in line with previous research that showed that subjects could not distinguish between line and segment symbols so their writing was still incorrect (Fajari, 2020; Safrina & Darmawan, 2016). The reasons given by the subject to explain their choice illustrate the misconception that occurred. The subject stated that the height of the pyramid is inside the pyramid and connects the peak point to the middle of the base of the pyramid and does not have to be perpendicular to the base of the pyramid. The cause of this misconception is that the teacher does not explain in detail the

definition of the height of the pyramid and more often gives practice questions. The subject is accustomed to doing practice questions in determining the height of the pyramid so that he can produce correct answers. In line with previous research that shows that classroom learning that is more often done by doing exercises than strong conceptual understanding can cause misconceptions (Fajari, 2020; Ainiyah & Sugiyono, 2016; Nurawwaluliza et al., 2021). The low level of confidence in answering is influenced by the subject's confusion when seeing the rotated pyramid. This causes the subject to feel doubtful about the line segment $\overline{OT}$ that becomes the height of the rotated pyramid. Meanwhile, the high level of confidence in giving reasons is caused by the subject being sure that the concept is correct.

In type 2 classification misconceptions, subjects were found to produce correct answers with a high level of confidence and provide incorrect reasons with high confidence in determining the base side of a triangular prism. The subject's answer was correct, namely the side plane ABC which is the base side of a triangular prism. The subject has understood that the base side of a triangular prism is a triangular side plane, but is still carried away by the general assumption that the base side is the base or is in the lowest position. This causes the subject to assume that the base side of the prism is a triangular side plane that is in the lowest or front position. This finding is different from previous studies that only showed that subjects experienced misconceptions about the base side of the prism which is considered the lowest side plane. The subject was confident in answering and providing reasons because the subject believed the concept was correct.

In type 3 classification misconceptions, subjects were found to produce incorrect answers with a low level of confidence and provide incorrect reasons with high confidence in determining the base side of a triangular prism. The answers produced by the subjects were incorrect because the reason for choosing the base side of a triangular prism was the side plane that was below. This reason emerged because the subjects understood that the base side of all geometric shapes is always below. In line with the results of previous studies that showed misconceptions in determining the base side of a triangular prism were caused by the subjects understanding the prism as a geometric shape that has a base and a lid, not a geometric shape that is limited by two congruent and parallel side planes (Ainiyah & Sugiyono, 2016; Fuat et al., 2020). The low level of confidence in answering was influenced by the subjects' difficulty in determining the side plane that was below a rotated triangular prism. Meanwhile, the high level of confidence in providing reasons was caused by the subjects believing that the concept was correct.

In type 4 classification misconceptions, subjects were found to produce incorrect answers with a high level of confidence and provide incorrect reasons with high confidence in determining prism and pyramid-shaped objects. This misconception is caused by subjects being accustomed to seeing only the visuals and not understanding the definition of prisms and pyramids so subjects assume that cubes and blocks are not prisms, cylinders are prisms, and cones are pyramids. This causes the answers and reasons produced by the subjects to be incorrect. This misconception occurs because teachers are not detailed enough in explaining which geometric shapes are prisms and pyramids, and are often separate in explaining prisms, cubes, and blocks. This is in line with previous research showing that the way teachers teach can cause misconceptions in determining prism and pyramid-shaped objects (Fajari, 2020; Fitriani & Rohaeti, 2020). Subjects are confident in answering and providing reasons because the subjects believe the concept is correct.

In the classification misconceptions of type 1 and type 3, it was found that subjects were hesitant to answer due to a lack of ability to project three-dimensional shapes. This finding is in line with the results of previous studies that showed low spatial ability causes hesitation in solving geometry problems (Lestari et al., 2015; Purnama Sari et al., 2018). Meanwhile, in the

classification misconceptions of type 2 and type 4, it was found that subjects were confident in answering because they could apply well-known concepts.

Correlational misconception is a misconception in determining the relationship between one object and another (Ainiyah & Sugiyono, 2016; Fuat et al., 2020; Fadhilah et al., 2019). In correlational misconceptions type 1 and type 2, subjects were found to produce correct answers and provide incorrect reasons in determining the relationship between the volume formulas for cubes, cuboids, and prisms. The subject's answer was correct, namely agreeing that cubes, cuboids, and prisms can use the formula $V = L\ alas \times tinggi$. The subject gave the reason that cubes, cuboids, and prisms have similarities, namely having the same height, the same number of sides, and the same number of corner points. The subject stated that the relationship between the three shapes was similar and there was no other relationship, even though cubes and cuboids are also prisms so they can use the formula. $V = L\ alas \times tinggi$. In correlational misconception type 1, it was found that the subject's low level of confidence in answering is caused by the subject's doubt that the cube can use the same formula because the length of its edges is the same. Meanwhile, the high level of confidence in giving reasons is caused by the subject's belief that the concept is correct.

In correlational misconceptions type 3 and type 4, subjects were found to produce incorrect answers and provide incorrect reasons in determining the relationship between the volume formulas of cubes, blocks, and prisms. The subjects' incorrect answers and reasons illustrate the misconceptions that occurred. Subjects made incorrect answers because they assumed that cubes, blocks, and prisms were different geometric shapes so their volume formulas were also different. This misconception was caused by the subject's understanding that a cube has a formula $V = S^3$, a block has a volume formula $V = p \times l \times t$, and a prism has a formula $V = L\ sisi\ alas \times t$due to reference books that did not explain the origin of the volume formulas for cubes and blocks derived from the volume formula for prisms. This is in line with previous research showing that reference books can cause misconceptions in determining the relationship between cubes, blocks, and prisms (Fitriani & Rohaeti, 2020). In correlational misconception type 3, the subject's low confidence in answering was caused by the subject's doubts about seeing the similarity between blocks and prisms, so there was a possibility that the same volume formula could be used. Meanwhile, the high level of confidence in providing reasons was caused by the subject being sure that the concept was correct.

In correlational misconceptions type 1 and type 3, it was found that subjects had a low level of confidence in answering because the subjects doubted their ability to apply their learning experiences and use them in solving problems. In contrast, subjects who experienced correlational misconceptions type 2 and type 4 had high confidence in answering because they were sure of their ability to apply their learning experiences and use them in solving problems. This is in line with the results of previous studies which showed that subjects with low self-efficacy tended to hesitate in solving geometry problems (Lestari et al., 2015; Purnama Sari et al., 2018).

Theoretical misconceptions are misconceptions about applying formulas (Ainiyah & Sugiyono, 2016; Fuat et al., 2020; Fadhilah et al., 2019). In theoretical misconceptions type 1 and type 2, subjects were found to produce incorrect answers and provide incorrect reasons in determining the volume and surface area formulas of pyramids. Subjects produced incorrect answers because they used the wrong prism volume formula and surface area formula. The cause of this misconception is that subjects assume that all geometric shapes have the same volume formula, namely $V = L\ sisi\ alas \times t$ height. and a wrong understanding of the surface area formula of a pyramid. This finding is in line with the results of previous studies which showed that subjects used the prism volume formula to find the volume of a pyramid and used an incorrect surface area formula (Muchyidin et al., 2020; Fitriani & Rohaeti, 2020).

In type 1 theoretical misconceptions, a low level of confidence in answering was found because the subject was unsure of his calculations. Meanwhile, a high level of confidence in giving reasons was caused by the subject being sure that the concept was correct.

From all types of misconceptions that occur, it can be concluded that misconceptions occur when subjects provide incorrect reasons with a high level of confidence. The third level or providing reasons for answers shows the concept used by subjects in answering first-level questions (Gurel, 2015; Arda et al., 2023; Suwarto, 2013). This is in line with previous research that shows subjects experience misconceptions when they feel confident that their learning experience is correct even though it is not under generally applicable concepts. If the level of confidence in providing reasons is low, then the subject cannot be said to have misconceptions but rather lacks of knowledge (Setyaningrum et al., 2018; Puspitasari, 2018). Researchers suggest that further research be conducted on appropriate learning media for each characteristic of misconception.

4. Conclusion

Based on the results of the study, subjects who experienced type 1 and type 2 classification misconceptions produced correct answers and incorrect reasons, while types 3 and type 4 produced incorrect answers and reasons in distinguishing between examples and non-examples. In types 1 and 3, the low level of confidence in answering was caused by the lack of spatial ability of the subjects. Meanwhile, the high level of confidence in answering in types 2 and 4 was caused by being confident in their learning experience.

Subjects experiencing correlational misconceptions type 1 and type 2 produce correct answers and incorrect reasons, while types 3 and type 4 produce incorrect answers and reasons in determining the relationship between one object and another. In types 1 and type 3, the low level of confidence in answering is caused by the low self-efficacy of the subject. In contrast to types 2 and type 4 where self-efficacy is high so that the level of confidence is high in answering.

Subjects who experience theoretical misconceptions in type 1 and type 2 produce incorrect answers and reasons for applying the formula. In type 1, the low level of confidence in answering is caused by the subject's doubts about their arithmetic ability. Meanwhile, in type 2, they are confident in their arithmetic ability so their level of confidence is high in answering. From all types of misconceptions, it can be concluded that misconceptions only occur in subjects who provide incorrect reasons with a high level of confidence.

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