



Analysis of Factors Causing Misconceptions in Plane Geometry among Fifth Grade Elementary School Students

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Paper received: 25-5-2025; revised: 26-9-2025; accepted: 30-10-2025

Abstract

Misconceptions are often the cause of low student mathematics learning outcomes. In this study the authors seek to uncover the factors that cause students' misconceptions about plane shapes. This study uses a qualitative method with a case study approach. This research is based on the problem that there are still many students who are wrong in answering several questions in the form of stories. In this study two students were taken using a purposive sampling technique as research subjects. From the research results, it was found that the cause of students' misconceptions in answering non-routine questions was the low understanding of students' definitions. The low understanding of definitions occurs because learning only relies on one teaching material in which the teaching material has very little information. In addition, the lack of use of teaching media by teachers results in students not being able to recognize other forms of flat shapes according to the definition. Apart from that, the lack of examples of flat shapes given makes students' understanding of definitions shallow. When given a flat shape with a different shape, students experience confusion.

Keywords: analysis; misconceptions; two-dimensional

INTRODUCTION

Mathematics is an abstract subject. Often students think mathematics is a very difficult subject (Nisa & Vebrianto, 2021). The difficulties experienced by students appear when students are given non-routine problems which students often find unable to work on (Shawan et al, 2021). Various kinds of reasons were put forward by students regarding the difficulties experienced when learning mathematics. Most students think that mathematics is just memorizing formulas (Nurhakim & Yundari, 2023). There are also those who argue that mathematics is not used in everyday life. Of course this shows that most students do not really understand mathematics. One of the underlying causes of this condition is misconception. Misconception is defined as an incorrect understanding of mathematical concepts, which hinders the process of solving math problems (Putri et al, 2024). Misconceptions make it difficult for students to connect concepts with their applications, so when faced with non-routine problems (especially in geometry), students tend to be confused or use inappropriate methods (Fitriani & Rohaeti, 2020). Indeed, mathematics is a concept based on problems that arise in life, so that learning mathematics is very necessary, both in terms of practical application and as a way to train logical thinking skills. Mathematics plays a role in all areas of life because arithmetic and logical reasoning taught in mathematics learning are the basis of science (Yeh et

al, 2019). The role of the mathematics teacher is in providing an understanding that mathematics is very useful for life by teaching mathematics through various forms of application and practice (Skovsmose, 2020). Learning mathematics is also very helpful in developing students' reasoning for solving problems related to everyday life (Resnick, 2020). As for the assumption that mathematics is difficult because students do not understand that formulas in mathematics are a pattern that is found as a problem-solving formulation if a similar problem is found in the future.

Mathematics learning, especially in elementary schools, plays a very important role for the continuation of the next stage of learning. However, many studies state that most students perceive mathematics as a subject they do not like. Such as research Rismawat & Khairiati (2021) which mentions several factors that influence students' interest in learning mathematics including learning facilities, interest factors, attention factors, peer factors, self-ability factors and health factors. The lack of interest in students learning mathematics was also revealed by Septiani & Abadi (2022) that the effect of excessive use of social media is very significant on students' interest in learning mathematics. The uncontrolled use of social media makes students addicted to social media. Sometimes students don't like mathematics because they think mathematics is difficult. Low interest in learning mathematics is the beginning of students' problems in understanding mathematics material. The low interest in learning mathematics is also often caused by learning that is carried out only by giving examples and then students are asked to work on questions making students feel like they are forced to memorize procedures and formulas without knowing the basis for the formula being derived so that the impact on students' conceptual understanding is incomplete. In fact, the key to success in mastering mathematics is understanding the concept (Fatqurhohman, 2016).

The difficulties experienced by students in learning mathematics often stem from a lack of understanding of concepts in the previous material. Mathematical concepts are arranged hierarchically. where each concept learned is always related to the concept studied previously (Meke et al, 2019). Of course, if students do not fully understand the previous concept, what happens when faced with new material is that students have less information in the structure of their thinking. When faced with problems in the form of word problems, students are required to identify and apply mathematical concepts that are appropriate to the problem (Verschaffel et al, 2020). According to Piaget in (Sa'aduddin et al, 2018; Subanji, 2016), when a person is faced with a new problem, he will call up the schemes that are in his mind, but if the schemes formed before are incomplete then there is the possibility of forming new schemes that complement the previous schemes. The formation of the new scheme is certainly influenced by how the student adapts to existing problems. If students are unable to adapt new information into their schemes, it will lead to fragmentation in the structure of their thinking. If this is not resolved immediately, the fragmentation in the structure of the student's thinking will increase, which will make it more difficult for students to understand subsequent concepts (Herna et al, 2016; Muslim et al, 2021). When faced with a problem and students cannot determine the concept correctly, the impact is that the student's final answer is wrong. Student mistakes in mentioning concepts that are different from scientific concepts are called misconceptions (Sadiah & Afriansyah, 2023).

Misconceptions in geometry learning significantly impact the development of students' mathematical thinking skills (Aprilia, 2025). Examples of misconceptions include assuming all

quadrilaterals are rectangles or misinterpreting the area formula as simply multiplying length and width, making it difficult for students to understand the properties and relationships between shapes. This condition causes students to experience serious obstacles in solving problems, especially non-routine or story-based problems (Fitriyani et al, 2023), because they use incorrect reasoning even though the procedures appear systematic. In line with the findings of other researchers, when studying geometry, incomplete conceptual understanding makes it difficult for students to move on to the next stage of thinking. For example, if a student doesn't know the name of a geometric figure, they won't be able to explain its properties (Herawati et al, 2022). This proves that the difficulty of learning geometry is a global problem for which it is very important to find a solution.

The problem found during observations was that there were still many students who did not understand the concept of a flat shape. This lack of understanding of the concept appeared when the researcher looked at the results of the daily tests which showed that many students did not reach the KKM. As many as 73% of students get remedial courses to improve their grades. Besides that, it also appears at the end of the semester exam. If seen from the students' answers to questions related to flat shapes, there are still many students who make mistakes. Concept errors or misconceptions can be seen from the answers of 2 children when working on a description problem related to the total area of two combined flat shapes. Students' difficulties in learning flat shapes were also expressed by several other researchers. Research by Simbolon et al. (2019) revealed that students' difficulties in learning flat shapes include abnormalities in visual perception, visual motor associations, difficulty using symbols, and a lack of understanding of reading. In addition, problems also arise from research results Lehmann (2022) that there are still many students who are not appropriate in using strategies and experience misconceptions in the problem of measuring the area of flat shapes.

From the description of the problem mentioned above, the researcher tries to find the root of the problem why students still experience misconceptions about flat shapes in elementary schools. Meanwhile, basically the material for flat shapes taught in elementary schools is material that is fundamental not at a complex stage, such as for example flat shapes taught at the junior high school level. Through this research, the author tries to answer the problem formulation that the author has determined, namely what factors cause misconceptions in students in understanding the concept of plane geometry in grade 5 elementary school students. As for in this article, the author limits the flat shapes that are discussed only on quadrilaterals.

METHOD

This research uses a descriptive qualitative method with a case study approach. The use of the case study approach itself was taken because the author found a case related to students' difficulties in working on questions about plane shapes (Sugiyono., 2017). As for the location of the research, it was conducted at one of the Muhammadiyah elementary schools in the Batang Regency, Central Java. The research subjects were taken from the fifth grade students as many as 2 students out of a total of 22 fifth grade students. The subject taking technique in this study used a purposive sampling technique. The sampling criteria were carried out by determining the subject came from class V elementary school who had received flat shape material, then by looking at the student data that obtained the lowest score from the daily test result data on flat shape material.

The instruments used in this study used a quadrilateral conceptual understanding test and semi-structured interviews. These two instruments have gone through a validation stage carried out by 2 validator mathematics lecturers at a university and were declared valid for use in collecting research data. The test instrument is used to see the extent to which students' understanding of concepts is possessed and the interview instrument is used to dig further about the causes of these misconceptions. In this research, misconceptions are defined as an incorrect understanding of mathematical concepts that hinder the solution of mathematical problems and the indicators used to classify the misconceptions that occur include: Classificational misconceptions, Correlational misconceptions, Theoretical misconceptions (Sri Rahayu & Afriansyah, 2021). Interviews were conducted with students and class teachers who supported them in order to obtain valid data. To show that the data in this study were valid, technical triangulation and source triangulation were carried out. Technical triangulation is done by comparing the results of tests and interviews then source triangulation is done by comparing the results of interviews conducted with teachers and students.

To find out the understanding of the concept of a rectangular shape, students are given a test in which the test instrument has been validated by two validators. The comprehension test instrument questions are shown in Figure 1

Instrumen Tes Matematika

1. Pak Toni hendak membangun rumah dari sebidang tanah yang ia miliki. Namun karena pak Toni merasa rumah yang akan dibangun luas nya kurang maka pak Toni berkeinginan untuk membeli tanah milik tetangganya agar panjangnya bertambah sebanyak 10 meter. Sebagai gambaran berikut ditunjukkan denah tanah milik pak Toni.

Dari denah tersebut yang berwarna biru merupakan tanah milik pak Toni, kemudian petak berwarna hijau merupakan tanah milik Pak Agus dan petak berwarna kuning merupakan tanah milik Pak Budi. Berdasarkan permasalahan tadi disebutkan bahwa pak Toni hendak menambah panjang tanah nya sebanyak 10m maka tanah milik siapa yang harus dibeli oleh pak Toni? Dan berapa luas tanah yang harus dibeli?

2. Manakah diantara bangun berikut yang termasuk Jajar genjang?

1 2 3 4 5

Math Test Instrument

1. Mr Toni wants to build a house on a plot of land that he owns. However, because Mr Toni felt that the house to be built was not large enough, he wanted to buy the land belonging to his neighbour so that the length could be increased by 10 meters. The following illustration shows the land plan belonging to Mr Toni.

Based on the map, the blue area represents Mr Toni's land, the green area represents Mr Agus's land, and the yellow area represents Mr Budi's land. According to the problem mentioned earlier, Mr Toni wants to extend his land by 10m. Whose land does Mr Toni need to buy? And how much land needs to be purchased?

2. Which of the following shapes is a parallelogram?

Figure 1. The instrument for understanding the material for a rectangular shape.

RESULT AND DISCUSSION

Result

Based on the results of the document review of students' daily test results on flat shape material, then 2 students were determined as research subjects who had the lowest scores. The subjects used in this study were the initials US as subject 1 (S1) and NE as subject 2 (S2). After obtaining the research subject, the researcher then gave the math test questions first to find out the subject's understanding of the concept. From the results of the tests that have been carried out by the two subjects, none of them answered correctly overall. To clarify in describing the results and discussion, the authors divide the results of the test and interview answers into 2 sub-chapters consisting of subject 1 answers and subject 2 answers.

Subject-1 (S1) Test Result

If you look at the answer from the first subject shown in figure 1, the subject has an overall misconception because none of the answers from the subject are correct, both number 1 and question number 2. The subject's answer to question number 1 of the question of whose land should be purchased, the subject mentions Mr. Budi's land. Automatically when the subject is wrong in choosing the land to be purchased, the area will be wrong. From these answers the subject thought that the length of Toni's land was the lower one, namely 15m. Then from subject 1's answer to question number 2 the subject only thinks that a parallelogram is only picture number 1. From this answer it can also be concluded that subject 1 has an understanding of the concept that is less related to the definition of a parallelogram. It appears from the students' answers that in writing what is known, subject 1 stated that the length and width are not appropriate. The subject stated that the length is 10 m and the width is 35 m. It is clear that this subject does not understand that the definition of length is the longest side, while 10 m is not the longest side of the plane figure whose area will be calculated. This error is categorized as a theoretical misconception (Sri Rahayu & Aldila Afriansyah, 2021).

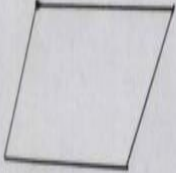
Luas tanah yg akan dibeli :
 Diketahui : panjang = 10 m X
 lebar = 35 m

 Luas : p x L
 = 10 m x 35 m
 = 350 m² X
 Yg dibeli tanah pak Budi.

Land area to be purchased:
 Known: length = 10 m; width = 35 m
 Area = Length x Width = 10 x 35 = 350 m²
 What was bought was Mr. Budi's land.

Figure 1. Subject 1's answer number 1

2. Gambar jajar genjang adalah no! X



The parallelogram image is number 1.

Figure 2. Subject 1's answer number 2

After seeing the answers to subject 1's test, interviews were then conducted to dig deeper into the understanding and root causes of misconceptions. From the interview results it is known that subject 1's understanding regarding the length of the rectangle is the bottom side of the rectangle. this was revealed in the following interview excerpts between researchers and subject 1.

R : What do you think is the length of this rectangle? (Points at the picture of Toni's land plan)
 SI : This sir (pointing to the part of Pak Toni's land below which has a size of 15 m)
 R : Why isn't the one at the bottom the longest?
 SI : mm, usually it's long, this one at the bottom, sir, if that's the name, it's wide

Figure 3. Snippet of subject 1 interview

Based on the excerpts from the interview with subject 1, it can be concluded that the knowledge of the subject's definition of the side length of a flat shape is not appropriate. The subject only relies on the memory of the examples given by the teacher. Then to find out the definition or forms of a parallelogram which is one part of the quadrilateral shape, interviews were conducted to find out the understanding of the flat shape material. The following is an excerpt of an interview regarding understanding the definition of a parallelogram and its forms.

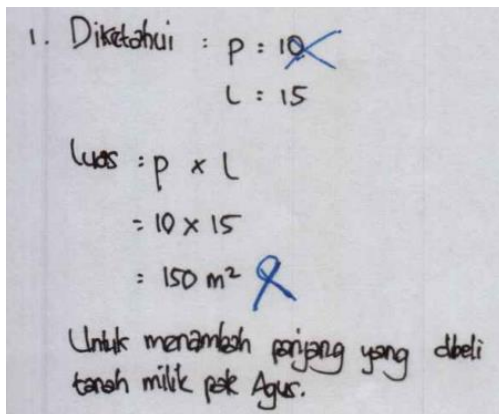
R : From the following picture, which one do you think is a parallelogram? (point to pictures of flat shapes like question number 2)
 SI : This is Sir (pointing at picture number 1)
 R : What is the definition of a parallelogram?
 SI : mmmm.. if I remember it is a quadrilateral with 2 pairs of parallel sides and the same length and the opposite angles are the same size
 R : Okay, then try to state the name of the other wake and its definition, can you try or not?
 SI : Number 2 is a square, sir, because the sides are the same, then number 3 is a circle, sir, because it is in the shape of a circle, then number 4 is a pentagon, sir, because it has five sides. The last one is a kite, sir, because it looks like a kite.
 R : That's not the definition if you just equate it with other things. Do you remember the definition that was taught?
 SI : hehe I forgot sir.

Figure 4. Snippet of subject 1 interview

Based on the interview excerpts, subject 1 only defines a flat shape like an object that has the same shape. The subject is not defined based on the properties of the geometric shape. Inadequate understanding of definitions results in the subject not being able to group plane shapes that have the same definition, therefore they only choose picture number 1 as a parallelogram without understanding that there are other parallelograms in special parallelogram shapes, namely squares and rhombuses. Based on the subject's incomplete understanding, subject 1 experienced a classification misconception (Sri Rahayu & Afriansyah, 2021). The subject was unable to distinguish which parts were part of a parallelogram.

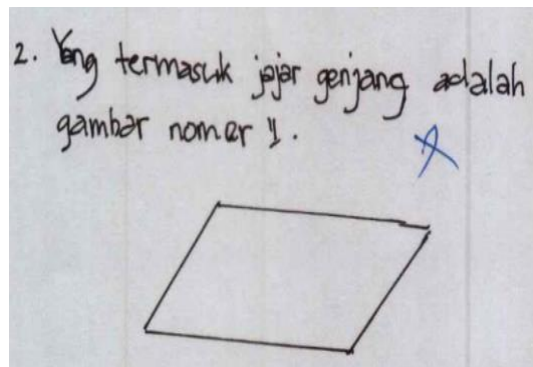
Subject -2 (S2) Test Result

Based on the results of test subject 2's answers as shown in Figure 5, answer number 1 was able to say the length correctly by choosing the answer of Mr. Agus' land so that the final answer was correct because if you choose the wrong plot to buy, even though the length is the same, the width you want to buy is different. However, in finding the area of land to be purchased, subject 1 showed the same error as subject 1. Subject 2 also made a mistake in choosing which side was the longest. It can be seen from the student's answer in writing what is known, the length is 10 m and the width is 15 m. This error is categorized as a theoretical misconception (Sri Rahayu & Afriansyah, 2021). Furthermore, for the answer to question number 2 shown in Figure 6, the subject also only mentions parallelograms in general, namely number 1. After obtaining an overview of students' understanding of the material through test questions number 1, the interview was continued with subject 2 to dig deeper about how deep the subject's understanding of the quadrilateral material. The following is an excerpt of an interview between the researcher and subject 2 regarding the subject's understanding of the material.



Known: length = 10; width = 15
 Area = Length x Width = 10 x 15 = 150 m²
 To add to the length of land purchased from Mr Agus.

Figure 5. Subject 2's answer number 1



The parallelogram is image number 1.

Figure 6. Subject 2's answer number 1

R	: Do you know which one is the length of Pak Toni's land? (point to the floor plan)
S2	: This is sir (pointing to the longest side of Toni's house plan)
R	: Are you sure? What's the reason?
S2	: uh... this is sir because it's near the road so it's possible that Pak Toni bought this one. But usually when it comes to questions, the length is usually this one, sir, the bottom one.

Figure 7. Snippet of subject 2 interview

From the interview results it is known that the subject cannot define length. Subject 2 cannot answer with certainty. The subject looked confused when asked about which side length. At first the students answered correctly but hesitated and mentioned the subject considering the example that is often given that the side length of a rectangle is always the bottom one. Then conducted further interviews to find out the definition of a given rectangular shape.

R	: Take a look at the following pictures, which one do you think is a parallelogram?
S2	: The number 1 sir
R	: What is the definition of a parallelogram that you know?
S2	: A quadrilateral with one of the parallel sides opposite the slant, sir.
R	: Sure that's the definition?
S2	: Forget it, sir, because for a parallelogram, there must be a slanted side like this, sir
R	: If the slanted side is only one parallelogram right?
S2	: mmno sir it's a pair of slanted ones.

Figure 8. Snippet of subject 2 interview

Based on the interview excerpts, subject 2 did not understand the definition of a parallelogram. This has the effect of also making the subject not aware of other forms of parallelograms based on similar definitions. To reveal more about the factors that influence the occurrence of misconceptions, interviews were also conducted with students as well as teachers in charge. The following is an excerpt of the interview with the teacher.

R	: In teaching definitions and concepts to students do you look for other reference sources yourself to increase your understanding of definitions or just rely on textbooks that are available?
T	: In learning I use worksheets, sir, because they are complete, there are examples, there are only exercises.
R	: Have you ever used props in teaching flat shapes?
T	: So far not sir, I emphasize more on students to practice working on the questions in the LKS

Figure 9. Snippet of teacher interview

The results of interviews with class teachers confirmed that indeed learning only relied on teaching materials that were less varied. There is no use of concrete media in learning, and LKS (worksheet) is the only teaching material used. The teacher's understanding of the concept of a flat shape that is lacking is one of the causes of the teacher's inability to improvise in learning. To clarify the research findings, a summary of the research results is shown in Table 1 and an overview of the relationship between the findings is shown in Figure 10.

Table 1. Summary of the research results

Aspect	Subject 1 (S1)	Subject 2 (S2)	Misconception Categories
Understanding side length	Assume the length is the bottom side (15 m), not the longest side	Initially pointed to the longest side, but then hesitated and followed the custom that the longest is the bottom side.	<i>Theoretical misconception</i> (the definition of the length of the side does not match the concept).
Determining the area of a shape	Wrongly determining the length-width side, so the area calculation is wrong	Experiencing a similar error, writing length = 10 m and width = 15 m	<i>Theoretical misconception.</i>
Definition of parallelogram	Answering parallelograms only picture number 1; not realizing special shapes (square, rhombus) are also parallelograms.	Defining a parallelogram as a quadrilateral with one slanted side, then confusing it by saying that it must have a pair of slanted sides.	<i>Classification misconception</i> (errors in recognizing and grouping).
Introduction to other forms	Relating shapes only to concrete objects (e.g. kites, circles, pentagons), without mentioning formal properties.	Calling out incomplete definitions and forgetting formal definitions, relying on visual examples	<i>Definition misconception.</i>
Causative factor	Relying on memory of teacher examples, not understanding formal properties.	The habit of learning with visual examples and a lack of emphasis on formal nature	<i>Definition misconception</i>

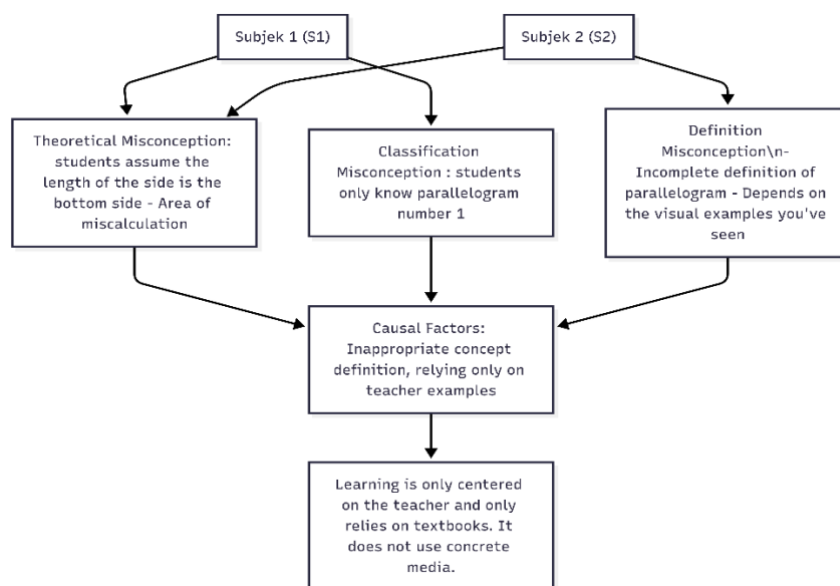


Figure 10. An overview of the relationship between the findings

Discussion

Based on the research results, it was found that knowledge of definitions as a basis for understanding mathematical concepts as a whole is still lacking. Based on test results and observations, the subject did not understand the definition of the length of a rectangle. The side length of the rectangle should be the longest side of the rectangle. Student knowledge only

follows the example of the teacher. The teacher only gives examples that are not varied, what happens is that students will assume that what is exemplified is the correct concept. Lack of understanding of concepts often makes students rely on trial and error in solving problems encountered when the problem given is a non-routine problem (Chirove et al, 2022).

From the answers of subjects 1 and 2, teachers can pay attention to the importance of providing students with an understanding of definitions. Subject 2 was able to answer correctly, but not because of a good understanding of definitions. Students will not make mistakes when the problem only involves one plane figure. Students simply enter what is known and then plug it into the formula they remember, which will produce the correct answer. In contrast, when given a problem with a complex plane figure, understanding definitions is essential for selecting what is known in the problem to solve the problem. The findings of this study are in line with those expressed by other researchers that when students lack a variety of examples in providing conceptual understanding, students often rely solely on memorizing formulas (Emanuel & Chamidah, 2021). The strategy of students memorizing formulas occurs because they do not fully understand the material.

Mathematics learning should be able to encourage students to think critically through reasoning on concrete problems so that students can connect previously understood concepts rather than just giving examples of questions that have an impact on students only memorizing formulas (Yuliani et al, 2019). One of the effects of the lack of variety of examples and non-routine questions can be seen in this study. When the teacher only teaches that the longest side of a rectangle is a horizontal side, students assume that the definition of length from a rectangular side is a horizontal part regardless of its size whether the horizontal side is longer or shorter than the vertical side. Misunderstanding the definition is a mistake that can be fatal. Especially in the concept of getting up this rectangular flat. According to Bruner, concepts are rules for describing an object and determining whether definitions or terms can be used or not (Yohanes, 2022). We can see from the results of the subject's answer in number 1 by incorrectly defining the length of the land even though the subject knows the formula for the area of a rectangle still produces the wrong answer. Therefore it is important to have a basic understanding so that misconceptions do not occur when working on mathematical problems.

In learning geometry material the role of definition is very important. The abstract nature of geometric material requires the imagination of students, therefore an understanding of definitions plays a role in helping students imagine a given flat shape. The lack of emphasis on understanding the definition arises from the results of this study. Lack of understanding of definitions results in students not understanding the rules that can be used when declaring that a flat shape is a parallelogram or not (Yohanes, 2022). Students do not understand that square, rectangle and rhombus are special forms of a parallelogram. Such errors arise when the teacher only gives general examples in teaching the definition of a parallelogram. Misconceptions about parallelograms because the initial understanding given by the teacher to students regarding the concept of parallelograms does not involve explaining the general form and special forms of parallelograms. Even though by definition there are other forms of parallelograms or better known as special form parallelograms. By definition, a square, rectangle or rhombus is a parallelogram in which the opposite sides are equal and the opposite angles are equal. From the results of the study it was revealed that the teacher only relied on teaching materials in the form

of LKS (worksheet) which in the LKS was based on observing the material given briefly. In his delivery tends to give examples that are less varied. This has an impact on students' understanding that is lacking. As at the beginning of the discussion, students cannot know the definition of the length of a rectangle and only rely on their memories from the examples given.

The teacher's understanding of definitions and basic concepts greatly influences the initial foundation of student knowledge. With a lack of understanding of concepts and definitions, teachers only rely on books and tend to directly discuss the subject matter in books (Irawan et al, 2016). In teaching mathematics in elementary schools, teachers should pay attention to the basic knowledge that must be taught to students so that in the future students can make the most of basic knowledge when studying or discovering new problems (Ningsih & Retnowati, 2020). Therefore teachers must continue to improve their competence in order to be able to explain mathematical concepts correctly. In addition, teachers must also be creative in teaching mathematics, especially at the elementary level, where students are psychologically unable to accept abstract thinking. The use of appropriate teaching media must also be considered by the teacher so that students are able to capture information and understand the material better.

Research Limitations

This study has the advantage of being able to deeply reveal the factors causing students' misconceptions in understanding the concept of quadrilaterals through a qualitative case study approach with strong data triangulation between test results, student interviews, and teachers. This study provides a concrete picture of how misconceptions are formed from a lack of understanding of definitions, a lack of variety in learning resources, and the absence of concrete media in learning. However, the limitations of this study lie in the very limited number of subjects, namely only two students from one school, so the findings cannot be generalized widely. Furthermore, the study only focused on quadrilaterals and did not cover the entire geometry material. It is possible that more student misconceptions would be found if the material was expanded. The theoretical contribution of this study lies in strengthening the understanding that misconceptions in mathematics originate not only from students, but also from inappropriate teaching practices, particularly in the delivery of definitions and the provision of examples that are not varied. Practically, this study has implications for teachers to pay more attention to the use of concrete media and a variety of problems in geometry learning, as well as the importance of strengthening concepts through a definitional approach so that misconceptions can be minimized early on.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

From the results of this study it was found that the roots of students' misconceptions in solving quadrilateral problems started from an incomplete understanding of the definition. This condition results in an error in the final result when students are given questions in the form of non-routine problems. With the existence of several distractors on the questions students experienced confusion because they did not master the definition. What students do then uses logic that deviates from the concept. There are subjects who associate the problem with existing distractors. For example, in determining the length to be purchased, the subject relates the

condition of the ground to the road. Because it is likely that the land to be purchased is the one on the side of the road. Even though the answer is correct, conceptually students cannot explain the reason. When exploring more deeply why students' understanding was shallow in understanding the concept of flat shapes, it was found that the teacher's lack of knowledge of the material being taught. The teacher is only based on teaching materials in the form of worksheets which only have a few discussions besides that the examples of questions are less varied. In addition, due to the lack of concrete learning media in teaching rectangular shapes, most students are unable to imagine geometric shapes according to their definition.

The teacher's knowledge of the material and the teacher's creativity in presenting teaching aids in learning geometry is very much needed. Props are useful when we explain definitions. For example when explaining the side length of a rectangle. By using rectangle props the teacher can explain that the side length of the rectangle is the longest side. Then from these props the teacher gives an example: if the shape is rotated a few degrees then the position of the sides will change so that students will better understand which part is the length and which part is the width of the rectangle. The use of visual aids in explaining the definition so that students do not experience misconceptions should be able to do with the initial step of mentioning the definition then the teacher gives a flat shape that fits the definition so that students will be able to group the flat shapes according to the definition.

Recommendations

Based on the research, several recommendations are proposed. First, since students' misconceptions mainly stem from unclear understanding of definitions, future research should prioritize the development and validation of more structured diagnostic instruments to map specific types of misconceptions related to definitions and the hierarchical classification of quadrilaterals. Second, learning interventions that emphasize definitional clarity, supported by concrete teaching aids, examples and non-examples, as well as variations in the visual orientation of shapes, are crucial to reduce misconceptions and strengthen students' conceptual understanding. Third, subsequent studies should involve a larger and more diverse sample of schools to obtain results that are more generalizable. Fourth, future research agendas may focus on exploring students' understanding of other geometry concepts, such as triangles or circles, and examining the impact of visual representations on the classification process. Finally, longitudinal research is recommended to investigate the continuous development of students' conceptual understanding while also considering the role of teacher competence in building accurate and clear foundational definitions.

REFERENCES

- Aprilia, R. P. (2025). Analisis miskonsepsi siswa pada materi geometri dengan menggunakan instrumen diagnostik four tier di kelas iv mis madinatussalam. *Jurnal Inovasi Pembelajaran Progresif*, 6(2).
- Chirove, M., Mogari, D., & Ugorji, O. (2022). Students' mathematics-related belief systems and their strategies for solving non-routine mathematical problems. *Waikato Journal of Education*, 27(3), 101–121. <https://doi.org/10.15663/wje.v27i3.822>
- Emanuel, E. P. L., Kirana, A., & Chamidah, A. (2021). Enhancing students' ability to solve word problems in Mathematics. *Journal of Physics: Conference Series*, 1832(1).

<https://doi.org/10.1088/1742-6596/1832/1/012056>

- Fatqurhohman, F. (2016). Pemahaman Konsep Matematika Siswa Dalam Menyelesaikan Masalah Bangun Datar. *JIPM (Jurnal Ilmiah Pendidikan Matematika)*, 4(2), 127. <https://doi.org/10.25273/jipm.v4i2.847>
- Fitriani, N., & Rohaeti, E. E. (2020). Miskonsepsi siswa pada materi geometri di tingkat sekolah menengah pertama. *Teorema: Teori Dan Riset Matematika*, 5(1), 9–16.
- Fitriyani, I., Astuti, E. P., & Nugraheni, P. (2023). Analisis kesulitan belajar geometri materi bangun datar pada siswa SMP. *Jurnal Pendidikan Sultan Agung*, 3(2), 163–174.
- Herawati, Herman, T., Suryadi, D., & Prabawanto, S. (2022). This content is covered by a Creative Commons license, Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0). Concept of Polygon: Case Study of Elementary Students' Difficulties. *Mathematics Teaching Research Journal*, 34(5), 34–47.
- Herna, Nusantara, T., Subanji, & Mulyati, S. (2016). The characterization of true pseudo construction In understanding concept of limit function. *IOSR Journal of Research & Method in Education*, 6(5), 2320–7388. <https://doi.org/10.9790/7388-0605037787>
- Irawan, I. P. E., Suharta, I. G. P., & Suparta, I. N. (2016). Faktor-faktor yang mempengaruhi kemampuan pemecahan masalah matematika: pengetahuan awal, apresiasi matematika, dan kecerdasan logis matematis. *Prosiding Seminar Nasional MIPA*.
- Lehmann, T. H. (2022). Learning to measure the area of quadrilaterals through decomposition and recomposition. *The Journal of Mathematical Behavior*, 66, 100952. <https://doi.org/https://doi.org/10.1016/j.jmathb.2022.100952>
- Meke, K. D. P., Jailani, J., Wutsqa, D. U., & Alfi, H. D. (2019). Problem based learning using manipulative materials to improve student interest of mathematics learning. *Journal of Physics: Conference Series*, 1157, 32099. IOP Publishing.
- Muslim, R. I., Usodo, B., & Pratiwi, H. (2021). Pseudo Thinking Process in Understanding the Concept of Exponential Equations. *IOP Conference Series: Earth and Environmental Science*, 1808(1). <https://doi.org/10.1088/1742-6596/1808/1/012043>
- Ningsih, E. F., & Retnowati, E. (2020). Prior knowledge in mathematics learning. *SEMANTIK Conference of Mathematics Education (SEMANTIK 2019)*, 61–66. Atlantis Press. Retrieved from <https://doi.org/10.2991/assehr.k.200827.118>
- Nisa, A., MZ, Z. A., & Vebrianto, R. (2021). Problematika pembelajaran matematika di sd muhammadiyah kampa full day school. *El-Ibtidaiy: Journal of Primary Education*, 4(1), 95. <https://doi.org/10.24014/ejpe.v4i1.11655>
- Nurhakim, L., Bistari, & Yundari. (2023). Understanding Of Straight – Line Geometry Concepts In New Students Of Mathematics Education. *Proceedings of the Borneo International Conference on Islamic Higher Education*, 290–296.
- Putri, J. H., Diva, D. F., Dalimunthe, N. F., Prasiska, M., & Irani, A. R. (2024). Miskonsepsi dalam Pembelajaran Matematika: Sebuah Tinjauan Literatur terhadap Penelitian-Penelitian Terbaru. *JagoMIPA: Jurnal Pendidikan Matematika Dan IPA*, 4(3), 580–589. <https://doi.org/10.53299/jagomipa.v4i3.749>
- Rahma Amadea Septiani, & Abadi, A. P. (2022). Studi Literatur: Pengaruh Penggunaan Media Sosial Terhadap Minat Belajar Matematika. *Didactical Mathematics*, 4(2), 355–361. <https://doi.org/10.31949/dm.v4i2.2156>
- Resnick, L. B. (2020). From protoquantities to operators: Building mathematical competence on a foundation of everyday knowledge. In *Analysis of arithmetic for mathematics teaching*

(pp. 373–429). Routledge.

- Rismawat, M., & Khairiati, E. (2021). Analisis Faktor-Faktor Yang Mempengaruhi Rendahnya Hasil Belajar Siswa Pada Pelajaran Matematika. *J-PiMat : Jurnal Pendidikan Matematika*, 3(1), 295–306. <https://doi.org/10.31932/j-pimat.v3i1.1129>
- Sa'aduddin Khair, M., -, S., & Muksar, M. (2018). Kesalahan Konsep dan Prosedur Siswa dalam Menyelesaikan Soal Persamaan Ditinjau dari Gaya Berpikir. *Jurnal Pendidikan Teori Penelitian Dan Pengembangan*, 3(5), 620–633. Retrieved from <http://journal.um.ac.id/index.php/jptpp/>
- Sadiyah, D. S., & Afriansyah, E. A. (2023). Miskonsepsi siswa ditinjau dari tingkat penyelesaian masalah pada materi operasi pecahan. *Jurnal Inovasi Pembelajaran Matematika: PowerMathEdu*, 2(1), 31–44. <https://doi.org/10.31980/powermathedu.v2i1.2718>
- Shawan, M., Osman, S., & Abu, M. S. (2021). Difficulties in Solving Non-Routine Problems: Preliminary Analysis and Results. *ASM Science Journal*, 16(3), 1–14. <https://doi.org/10.32802/asmscj.2021.800>
- Simbolon, H., Sofiyani, & Ramadhani, D. (2019). Analisis Kesulitan Belajar Matematika Materi Bangun Datar SD Negeri 7 Langsa. *Basic Education Studies*, 2(1), 100–111.
- Skovsmose, O. (2020). *Critical mathematics education*. Springer.
- Sri Rahayu, N., & Aldila Afriansyah, E. (2021). Miskonsepsi Siswa SMP pada Materi Bangun Datar Segiempat. *PLUSMINUS: Jurnal Pendidikan Matematika*, 1(1), 17–32.
- Subanji. (2016). *Teori Defragmentasi Struktur Berpikir dalam Mengonstruksi Konsep dan Pemecahan Masalah Matematika*. (February).
- Sugiyono. (2017). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung: Alfabeta.
- Verschaffel, L., Schukajlow, S., Star, J., & Van Dooren, W. (2020). Word problems in mathematics education: a survey. *ZDM - Mathematics Education*, 52(1), 1–16. <https://doi.org/10.1007/s11858-020-01130-4>
- Yeh, C. Y. C., Cheng, H. N. H., Chen, Z. H., Liao, C. C. Y., & Chan, T. W. (2019). Enhancing achievement and interest in mathematics learning through Math-Island. *Research and Practice in Technology Enhanced Learning*, 14(1). <https://doi.org/10.1186/s41039-019-0100-9>
- Yohanes, R. S. (2022). Miskonsepsi dalam pembelajaran matematika dan cara mengatasinya. *Prosiding Nasional Pendidikan : LPPM IKIP PGRI Bojonegoro*, 41–52. Retrieved from <https://prosiding.ikipgribojonegoro.ac.id/index.php/Prosiding/article/view/1595>
- Yuliani, R. E., Suryadi, D., & Dahlan, J. A. (2019). Analysis of mathematics anxiety of junior high school students. Analysis of mathematics anxiety of junior high school students. *IOP Conf. Series: Journal of Physics: Conf. Series*, 042053(1157). <https://doi.org/10.1088/1742-6596/1157/4/042053>