

# Improving the Ability of Prospective Teachers: Errors Analysis of Material Geometry and Prevention Strategies

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Research article

# Improving the Ability of Prospective Teachers: Errors Analysis of Material Geometry and Prevention Strategies

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**Abstract.**

This study analyzes the errors made by students when studying geometry and provides prevention strategies for prospective mathematics teachers. The method used in this study is qualitative descriptive method. The instruments used were tests and interviews involving 16 prospective mathematics teacher respondents. Data were validated using the triangulation techniques by comparing answers based on test and interview results. The results of the research show the following conceptual errors made by the students: (i) while studying the concept of scale, it was seen that the writing of the scale can be expressed in the form of a fraction – the strategy to increase teacher’s TPACK ability is to ask students to analyze the difference between ½ and 1:2; (ii) errors in understanding the concept of a circle – the strategy to prevent this is to show a sample of a circular shape to the students; (iii) errors in distinguishing between the concepts of a circle and round – the strategy to prevent this is to remind students of the lyrics of the song “My hat is round” or the shape of the snack “tofu is round” and ask them to compare it with a ball; and (iv) limited understanding of the principle of the size of a triangle, namely the square of the longest side is less than the sum of the squares of the other sides – the strategy to prevent this is to ask students to analyze the patterns of pairs of sides. The novelty of this study not only analyzes the possible mistakes made by prospective teachers and students in teaching and studying geometry, respectively, but also provides an overview of the solution steps that teachers can take if their students face difficulty in learning geometry.

**Keywords:** TPACK, errors analyze, geometry

## 1. Introduction

The era of revolution 4.0 which is marked by technological advances has had a rapid influence on the world of education. The education system continues to develop from a conventional system to an all-digital system. Thus, teachers are required to master technology in order to support learning activities. According to [1] teachers must actively participate in the technology integration process and have several competencies to use the technology available in the learning environment appropriately and effectively. For this reason, it is necessary to prepare since becoming a student teacher candidate to be ready with mastery of TPACK when becoming a teacher. One of the efforts to

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support this is by targeting LPTKs that produce prospective teachers. PGRI Semarang University as one of the LPTKs seeks to take a role in preparing prospective teachers who have good TPACK mastery.

Mastery of concepts is an absolute requirement for prospective teachers in mastering TPACK, especially mastery of content knowledge (CK) aspects. As is well known, CK is one of the seven aspects of TPACK abilities that must be possessed by teachers [2].

One of the materials that requires mastery of concepts is geometry. Learning geometry is reasoning, linking symbols, connecting structures to get an understanding and applying these concepts in real situations[3]. However, in reality students experience problems in learning geometry[4,5]. This is in line with[6] who said that geometry is one field that is very weakly absorbed by school students. As stated by[7] that students who can memorize geometric proofs without understanding the steps of the proof process, students have failed to understand the logic of the proof.

The low mastery of students' concepts can be seen from the number of mistakes made by students in working on the questions given. In solving the questions given by the teacher, students still experience some errors[8]. Errors in solving problems are errors made by students because they only work on one or two questions from several stages of problem solving or are not in accordance with the problem solving steps[9]. One of the factors that cause misunderstandings experienced by students is due to the inheritance of misunderstandings handed down by their teachers [10]. Errors are something that is natural for students to do in the learning process, but if mistakes are made frequently and in sufficient capacity, attention and follow-up are needed so as not to have a bad impact on students. [11] revealed that if students are willing to learn from their mistakes, then their understanding of a knowledge will be better. This is so that students do not repeat the same mistakes when faced with the same or similar problems.

Errors that more often occur in students when working on questions are errors in concepts. Misconceptions conveyed at one level of education can lead to misconceptions up to a higher level of education[12].

According to Malau in[13] explains that things that can be the cause of question errors include, lack of student understanding of the subject matter or even prerequisite material, lack of student mastery in language or mathematical symbols, students misinterpret or use formulas, students are wrong or less thorough in calculations, students forget concepts, how to teach teachers who do not support understanding of the material or concepts being taught and teachers pay less attention to students in learning. [2] stated that teachers play an important role in eliminating misunderstandings that students have.

Research involving mastery of content, learning strategies and the use of technology in education (TPACK) synergistically has been carried out[14] which has succeeded in developing instruments to measure teachers' TPACK abilities. In addition,[11] develops TPACK in high schools [11]. From these reference studies, this study tries to develop by presenting prevention strategies that can be done by teachers so that students' misconceptions can be avoided.

## 2. Methodology

<sup>5</sup>This type of research is descriptive qualitative research. Qualitative research is a research method based on the philosophy of postpositivism, used to examine the condition of natural objects where the researcher is the key instrument[15]. This study describes student errors in solving geometry problems. <sup>7</sup>The subjects in this study were 16 students of the Mathematics Education study program at PGRI Semarang University. <sup>7</sup>Data collection techniques used in this study were tests and interviews. The test is given as many as 4 questions which are a reference for analyzing the mathematical concept errors of prospective teacher students on geometry material. According to[16], qualitative data analysis was carried out as follows: 1) all data was prepared and collected for analysis, 2) developed and coded all data for analysis, 3) coded based on descriptions, 4) the results found were presented for analysis. reported, 5) the results that have been found are validated for accuracy. <sup>11</sup>Checking the validity of the data in this study using technic triangulation

## 3. Results & Discussion

Efforts to analyze geometric concept errors and strategies for prevention by increasing students' TPACK abilities that can be done are by giving <sup>1</sup>tiered questions from the level of introduction (Problem 1), understanding (Problem 2) to questions that are understanding development (Problems 3 and 4). The following is a presentation of research results along with theoretical and empirical discussions.

### Question 1

The distance from Wawan's house to the school is 600 m. The distance from Wawan's house to the school on a map is 12 cm. The scale of the plan is...

The following are the results of student answers test answers

Interview answers

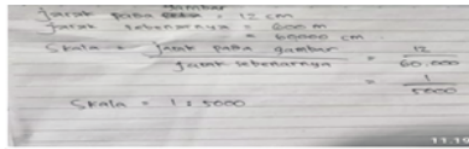


Figure 1: The form of the concept error of question number 1.

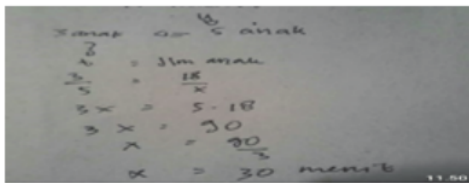
4 Based on the results of answers and interviews with students for question number 1, students have answered well and correctly. However, after further digging with questions about the concepts of comparison and fractions, most of the students experienced errors in understanding the concepts  $a:b$  and  $\frac{a}{b}$ . Students say that comparisons can be expressed in the form of fractions. Students still think the same between  $a:b$  and  $\frac{a}{b}$ . The error occurred because students did not really understand the concept of the definition of  $a:b$  dengan  $\frac{a}{b}$ . This is in line with [4] which states that the subject cannot solve the problem correctly due to a lack of understanding of the concept. One of the factors that cause the concept error is due to the lack of initial knowledge possessed by students [17].

**Question 2**

A dirty classroom takes 18 minutes if 5 children are cleaned. If the class is cleaned by 3 children, then the time required is ...

10 The following are the results of the test answers and interviews with students

Test Answers



Interview answer



Figure 2: The form of the concept error of question number 2.

<sup>4</sup> Based on the results of answers and interviews with students for question number 2, all students have answered well and correctly, it's just that a little correction in the writing section of the comparison should be  $3 : 5$  and  $18 : x$ . In question number 2, students made a few mistakes in the transformation in the comparison writing section. This is in line with the opinion (8) which says that the transformation errors made by students are not appropriate when converting questions into mathematical models.

### Question 3

There is a statement "the angles of a parallelogram that are opposite are equal". Do you agree with that statement? Prove it

Here are the results of the test and interview answers

Test Answers

Interview answer

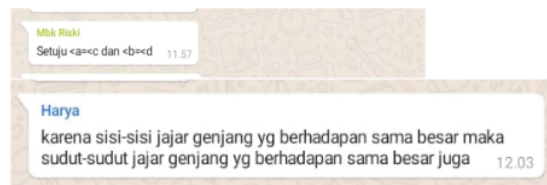


Figure 3: The form of the concept error of question number 3.

<sup>4</sup> Based on the results of answers and interviews with students for question number 3, students have answered correctly but have not been able to prove the nature of parallelograms. Students experience errors in understanding the concept of definition and properties of parallelograms so that students experience many mistakes about understanding the relationship between flat shapes. This is as stated [18] mastery of students in geometry material is in mastering the concept of the position of points, lines and other fields. [16] stated that as many as 65% of students out of 900 students could not be able to answer problems related to triangles and quadrilaterals.

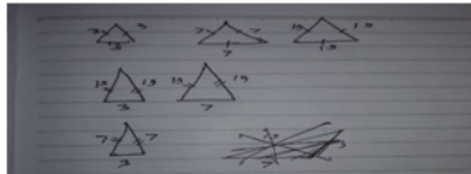
### Question 4

How many triangles can be formed from 3,7,19? If (3,3,3) is one of the examples.

10

The following are the results of the test answers and interviews with students

test answers



Interview answer

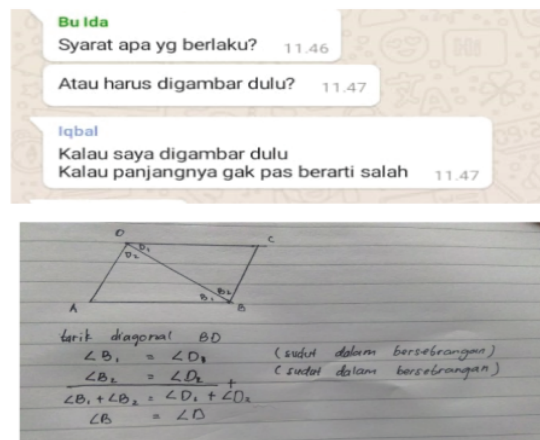


Figure 4: The form of the concept error of question number 4.

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Based on the results of test answers and interviews with students for question number 4, students solve problems with a trial and error system by drawing triangles. Students do not understand and apply the concept of triangle prerequisites. This is in line with the opinion [9] which says that students experience a lack of understanding in the concept of flat wake.

8

## 4. Conclusion and Suggestion

### 4.1. Conclusion

Based on the results of the research and discussion, it can be concluded that the conceptual errors made by students in studying geometric concepts are errors in

understanding the concepts of comparison and fraction definitions, errors when transforming problems that should be written in the form of  $3 : 5$  and  $18 : x$ , failure to develop an understanding of the concepts used. In this case, they are unable to prove the magnitude of the opposite angle on a parallelogram, and are unable to use the prerequisite concept of a triangle. Strategic strategy for prevention by increasing the teacher's TPACK ability is by giving tiered questions starting from the level of knowing, understanding concepts to developing conceptual knowledge.

## 4.2. Suggestion

From the results of this study, the role of the lecturer is needed to minimize errors that occur. It aims to avoid repeating mistakes in solving the next problem. Given that geometry is a material that must be mastered by prospective mathematics teacher students. Lecturers can observe and analyze some conceptual errors made by students by providing questions that require basic concepts to explore conceptual errors made by students and then provide tiered questions starting from the level of knowing, understanding concepts to developing their conceptual knowledge.

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