Justification Strategies of The 7th Grade Students in Understanding Triangles’ Concepts

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Abstract— Triangle is one of the fundamental concepts in geometry which has to be studied in secondary schools. Students have many difficulties to implement maths’ reasoning and to understand concepts of the triangle. If students’ difficulties have to be addressed and facilitated, then the students understand the concept of triangles. One is called a mathematics justification. It is an important skill for students to develop mathematical reasoning for learning and understanding mathematical concepts. This study used a descriptive-qualitative approach aimed for assessing students’ justification strategies in understanding triangle concepts. This study was conducted in the MTs’ Hidayatul Hasan, Lumajang. Out of class, which was out of five classes of grade seven, were selected purposively as the sample of this. All students’ were given both mathematical ability and justification tests. Six volunteer students, every two students with low, medium and high maths’ abilities, respectively, were selected as respondents. All respondents were individually interviewed based on the answer to the justification test. Our results agreed to some findings that the geometry’s concepts are only focused on computational skills, lack justifications in the understanding of what concepts and without explaining why the used strategies are appropriate or correct.

Keywords—Congruent; mathematics justification.

I. INTRODUCTION

Geometry is a field of mathematics that must be studied by all student at the level of primary and secondary education. Studying geometry is an important component of learning mathematics because it allows students to analyze and interpret in other areas of mathematics [1]. Triangle is one of the fundamental concepts in geometry which has to be studied in secondary schools. Students have many difficulties to implement maths’ reasoning and to understand concepts of the triangle. Several studies suggest that students experience difficulties in understanding geometry, which is a crucial component of mathematics education. In Cyprus, the 7th-grade students were reported having difficulties in utilizing the related formula of triangle’s areas, since they only memorized the formula without appropriated reasons [1]. The geometric proof is one of the most difficult parts of the students’ learning of mathematics [2]. Similarly, the 7th-grade students in Slovak cannot recognize a geometric shape, in particular, if it is pictured in different shapes [3]. For example, if a student learns the concept of a triangle, with the base of the triangle always below, then the constructed concept of understanding is that the triangle should always be as described. When students are faced with different problems, students will experience difficulties. The 8th-grade students in the central district of a northern province of Turkey, indicated the reasons for students’ misconceptions about geometric concepts as follows: they mostly learn by rote, and they cannot understand concepts exactly [4].

This indicates that students have not understood the concept of triangle and students’ reasoning to justify a logical statement relating to the concept of triangle very low. If students’ difficulties have to be addressed and facilitated, then students might be conditioned to understand the concept of triangles. Students need to have a justification strategy in explaining an idea to make the students’ reasoning clear. When students are justified, students use students’ knowledge and reasoning to link ideas. Thus the reasoning of students’ conceptual understanding will increase. One strategy is called a mathematics justification. It is an important skill for students to develop mathematical reasoning for learning and understanding mathematical concepts. Justification is an important goal for students doing mathematics [5]. Justifications as an underlying way of reasoning [6,7]. In the classroom, where students have opportunities to participate in mathematical argumentation and justification, the quality of students’ reasoning, and justification ability can be enhanced.

Justification pushes students beyond a procedure to a deeper understanding of the math. In order to justify their thinking, they have to justify not just the hows, but get to the whys of what they’re doing [8]. Justification builds up students’ reasoning with a better way. It happens because in justifying, students are not only asked to explain their answer from solving mathematics problems, moreover, students are asked to explain why those solution can be used and their answer is right.

Students experience increased understanding of mathematical concepts when taught by using justification strategies [9]. Mathematically, students must learn to justify the results obtained, explain what they think is right or wrong, and convince others to communicate their mathematical ideas. A student who has a justification strategy is able to construct new knowledge independently and pushes students beyond a procedure to a deeper understanding of the math [10] with students justifying the strategy, this will help students obtain mathematical abilities effectively and efficiently. Hence, students are motivated to utilize a justification strategy in explaining students’ reasoning in solving triangle problems.

II. METHODS

A. The aim of the study
This study used a descriptive-qualitative approach that aimed to assess students’ justification strategies in understanding triangle concepts.

B. Sample

This study was conducted in the MTs’ Hidayatul Hasan, Lumajang. In class, which was out of five classes of grade seven, were selected purposively as the sample of this study. Six volunteer students, every two students with low, medium and high maths’ abilities, respectively, were selected as respondents.

C. Procedure

All students’ were given both mathematical ability and justification strategies tests. The justification strategies test consisted of three problems which related to concepts of triangles. By involving students’ math value, the results were ranked into three categories namely low, medium and high maths’ abilities, respectively. Six volunteer students, every two students with low, medium and high maths’ abilities, respectively, were selected as respondents. All respondents were individually interviewed based on the answer of the justification strategies test.

III. RESULTS AND DISCUSSION

A. Item Tests

Three item of justification strategies test related of triangle concepts, given as follows.

1) Statement: A triangle may have two right angles. According to your knowledge, the above statement is true or false. Please explain!

2) Statement: Given the triangle ABC which is congruent with the triangle QPR. There is at least one angle of ABC is. According to your knowledge, the above statement is true or false. Please explain!

B. Students Interview Part

To make it easier, note that SH, SM, and SL denote the high, medium and low maths’ ability subjects, respectively.

Result of the SL and SM maths’ ability subjects:

Subject SL and SM have much difficulty in justification strategies tests, seen from the justification strategies used by students to answer questions about the concept of triangle, as follow:

After interviewing the subject’s answer. In figure 1, subjects SL are still confused with the statement on the item test. SL does not know the size of the triangle and the size of right angle. SL can not link between the information contained in the statement with their answers. Students who do not understand triangles based on their angle size will find it difficult to conclude that a triangle may have two right angles.

The justification strategies of the SL subject (figure 2) is only based on the visual appearance of the triangle image. SL assumed that if there are two triangles of different sizes, then the angle were also different. SL do not know the hidden information contained in the image that refers to the concept of triangle and the students had not understood the concept about the congruent. Obviously, the item test provided a clearly hint that the two triangles were congruent.

In figure 3 showed the justification strategy for SM subject based on the information obtained on image item. SM do not do calculations using circumference of triangle formulas in their answers and there are no valid steps to justify their answers.

Result of the SH maths’ ability subjects, as follows:
is at least one angle ABC is $45^\circ$. Finally, SH can write size of
ABC triangle is equal to the size QPR triangle.

Based on the picture in the statement of item tests, number
three has provided enough information for most students to
justify it, although it actually needs to be proven by
calculation. The justification strategies of the subjects SH
(figure 6) is with some procedural steps involving the formula
and calculation. SH has known the circumference of the
triangle and she said: "circumference of the triangle is side +
side + side", SH calculations involving the base and height of
the triangle with the result of circumference triangle as follow:
$\text{circumference of ABC is } 11 \text{ cm}, \text{circumference of PQR is } 11 \text{ cm}$. Finally, SH can
determine the circumference of the triangle.

IV. CONCLUSION

From the results of this study, the answer to a subject with
low ability does not fit the context of the statement. The SL
answer is to describe how to get answers, not to explain why
to take those steps until finally making the conclusion that a
statement is true or false. It can be concluded that subjects
with a low ability that justification strategies are mainly
descriptive and students answer not contain valid justification
strategies and uninformative justification. So that, the valid
reasoning process does not exist in the student's justification
strategy. A concise student Justification strategies indicate
that students' reasoning and understanding of student math
concepts are still low.

The answer to a subject with medium ability, in
accordance with the context of the statement. But the SM
subjects has not shown some procedural steps involving
formulas and calculations. So that the student's justification
strategies allows mistakes and contains concepts that have not
been detailed.

The answer to a subject with high ability, in accordance
with the context of the statement, is more complete by using
basic mathematical information and concepts. Finally,
students can complete a justification strategy through valid
steps according to their own language. The correct
justification strategies are based on the basic concept and the
context of the statement. The justification strategies of the
subject SH is mostly clear and conceptually correct. In this
finding prioritizes students' justification strategies in solving
problems related to the concept of triangles.

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