

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 reasonings [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 an 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

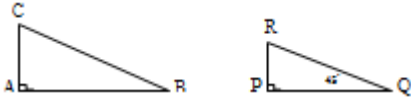
All students' were given both mathematical ability and justification strategies tests. The justification strategies test consisted of three problems which related to concepts of triangles. By involving students' math value, the results were ranked into three categories namely low, medium and high maths' 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

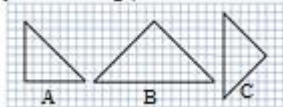
A. Item Tests

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:

Salah karena segitiga hanya memiliki sudut lancip
Itu ena karena sudut lancip
salah

Figure 1. Answered Item Test 1 of the SL maths' ability subjects

Salah, karena segitiga ABC besar dan
Segitiga PQR kecil

Figure 2. Answered Item Test 1 of the SL maths' ability subjects

Jawab benar, karena ~~ket~~ ukurannya ~~ket~~
Pangannya lebih besar
Sisi

Figure 3. Answered Item Test 1 of the SM maths' ability subjects

Subjects SL and SM were individually interviewed based on the answer of the justification strategies item test, as follows:

- R : what is the size of right angle?
SL : (emmmmm)
R : Please explain, how can you answer if the statement of number two is false?
SL : because ABC triangle is big and QPR triangle is small, so the size of the angle is different based on statement number two. According to
R : your knowledge, what the meaning of congruent?
SM : congruent is similarly
R : if both of triangle are congruent, then what about the angle size?
SM : not same
R : Based on statement number three, what do you know about the circumference of triangles?
SM : side + side + side

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:

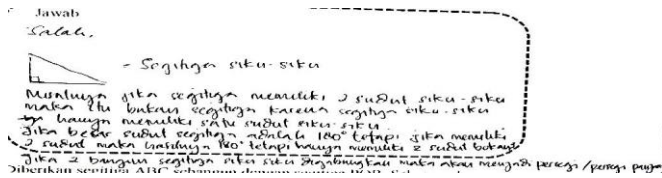


Figure 4. Answered Item Test 1

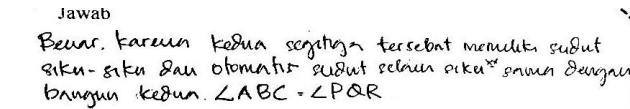


Figure 5. Answered Item Test 2

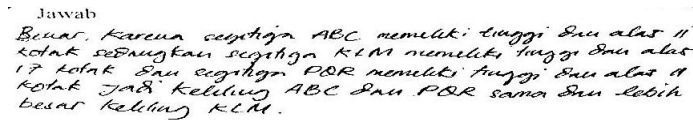


Figure 6. Answered Item Test 3

Subjects SH were individually interviewed based on the answer of the justification strategies item test, as follows:

- R : what do you know about triangles?
 SH : Triangles is a polygon that has three angles
 R : Please explain, how can you answer if the statement of number one is false?
 SH : if 2 right triangles are combined then it will be a rectangle
 R : based on statement number two. According to your knowledge, what the meaning of congruent?
 SH : congruent is similarly
 R : so, ABC triangle equal to PQR triangle?
 SH : not same
 R : and then, two triangles are said to be "congruent" if....
 SH : angles and shapes the same
 R : Based on the statement of number three, how do you learn and remember the formulae of triangles?
 SH : I learned it by writing and memorizing
 R : what do you know about the circumference of triangles?
 SH : side + side + side

Justification strategies on item test number one (Figure 4), subjects SH proposed the pictures as justification strategies for why the process works in this case. Based on the picture, SH describes the concept of the number of angles on a triangle, SH is able to obtain additional information based on the concept understood. Based on the acquired information about the number of angles and the size of the triangle angle, the SH subject is finally able to justify the statement correctly.

In Figure 5, subject SH begins the justification strategy of the concept congruent triangle. SH can obtain additional information based on a concept understood that can determine the angular size of other unknown triangles in the image. From these answers, students appear to be trying to show that there

is at least one angle ABC is 45° . 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: ΔABC is 11 cm, ΔKLM is 17 cm, ΔPQR is 11 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.

ACKNOWLEDGMENTS

The authors thank to the MTs Hidayatul Hasan Lumajang, Mrs. Retnowati as the maths teacher, and especially all students of the VII^C grade, who had enthusiastically supported and had involved in this study.

References

- [1] A. Özerem, "Misconceptions in geometry and suggested solutions for seventh grade students", *Proc. Social and Behavioral Sciences*, vol 55, pp. 720-729, 2012.
- [2] L. Fan, M. Mailizar, M. Alafaleq, & Y. Wang, "A Comparative Study on the Presentation of Geometric Proof in secondary Mathematics Textbooks in China, Indonesia, and Saudi Arabia", *ICME*, pp. 53-65.
- [3] K. Žilková, "Misconceptions in Pre-service Primary Education Teachers about Quadrilaterals", *Journal of Educational Psychology, and Social Sciences*, vol. 3(1), pp. 30-37, 2015.

- [4] C. Biber, A. Tuna, & S. Korkmaz, "The mistakes and the misconceptions of the eighth grade students on the subject of angles", *European Journal of Science and Mathematics Education*, vol. 1(2), pp. 50–59, 2013.
- [5] B. Glass & C. A. Maher, "Students Problem Solving and Justification", *Proc. Conf. of the International Group for the Psychology of Mathematics Education*, vol. 2, pp. 463-470, 2004.
- [6] I. Whitacre, B. Azuz, L. L. C. Lamb, J. P. Bishop, B. P. Schappelle, & R. A. Philipp, "Integer comparisons across the grades: Students' justifications and ways of reasoning", *Journal of Mathematical Behavior*, vol. 45, pp. 47–62, 2017.
- [7] P. Tsamir, D. Tirosh, & E. Levenson, "Exploring the Relationship Between Justification and Monitoring among Kindergarten Children", *CERME*, Vol. 6, pp. 2597-2606, 2010.
- [8] M. E. Staples, J. Bartlo, & E. Thanheiser, "Justification as a teaching and learning practice: Its (potential) multifaceted role in middle grades mathematics classrooms", *Journal of Mathematical Behavior*, vol. 31(4), pp. 447–462, 2012.
- [9] J. J. Lo, T. J. Grant, & J. Flowers, "Challenges in deepening prospective teachers' understanding of multiplication through justification", *Journal of Mathematics Teacher Education*, vol. 11(1), pp. 5–22, 2008.
- [10] M. Staples, J. Bartlo, & M. Staples, "Justification as a learning practice : Its purposes in middle grades mathematics classrooms", *CRME*, 2010.