ICEE-2

Students Error Analysis in Solving Mathematical Communication Problems of Square and Triangle Material For 7th Grade Based On Watson Criteria

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Abstract. This study aims to analysis student errors in solving mathematical communication problem of square and triangles material based on error criteria according to Watson . The research design used was aqualitative descriptive study. The study was conducted in class VII junior high school in Subang with a total of 32 students . The instrument used in this study was a mathematical communication skills test in the form of a description of six questions that had been validated to one Mathematics Education lecturer and one mathematics subject teacher . The results of research in the form of answers of students in the identification based on Watson Watson criteria is obtained percentage of each category of *inappropriate data (ID)* of 5.72% , *inappropriate procedure (IP)* of 20.31% , *lost data (ommited data/ OD)* 9.89 %, *omnited conclusion (OC)* 17.69%, *response level conflict (RLC)* 1.56%, *indirect manipulation (UM)* by 4.16%, *skills hierarchy problem (skills hierarchy problem/ SHP)* 10.93% , *and in addition to the seven categories above (above other/AO) of* 44.26%. Based on this percentage it was found that in categories *other than the seven categories above (AO)* were the most common errors made bystudents.

Keywords: error analysis, mathematical communication, square and triangle

INTRODUCTION ~ Mathematics is considered important in every country in the world (Mahanta, 2012). Students are required to learn mathematics which is considered as a basic education, because mathematical skills become very important in every job (Sujadi, 2018). In order to face the various challenges that have emerged in the 21st century today or better known as the era of globalization, formal efforts are made by the government to improve human resources. In the world of education one of them, which is the domain in preparing students as future generations to be more competent (Gravemeijer, Stephan, Julie, Lin, & Ohtani, 2017). Including mathematical competence, as a form of readiness of individual insights in acting to face a challenge in certain mathematical situations, and then identify (Højgaard, 2009).

One of the competencies that must be mastered by students is communication skills. Communication is an important part of student learning (Aini, Priatna, & Priatna, 2019). Communication skills that students learn today can be useful for them in the future (Wichelt, 2009). This is in line with the statement that good communication skills are valuable skills in the world of work and everyday life (Zubaidah, 2016). NCTM states that one of the main standards of mathematics learning is mathematical communication skills (Anintya, Pujiastuti, & Mashuri, 2017). Mathematical communication skills in learning mathematics are needed to be developed. That is because,

through mathematical communication, students can arrange mathematical thinking both orally and in writing (Qohar, 2011). Students who have good communication skills are able to create diverse representations, and will find it easier to find alternatives in problem solving (Anintya et al., 2017).

There are two forms of mathematical communication skills, namely oral and written (Prafianti, Dasari, &Jupri, 2018). Oral skills, when students express ideas and thoughts about mathematics to friends or teachers in class (Son, 2015). Whereas the skills of writing (writing) that is, when students express the ability to use pictures, tables, diagrams, graphs, algebraic expressions. This research emphasizes mathematical communication skills in writing skills. In this study, the material chosen was triangles and squares.

In the learning process experienced by students does not always run smoothly as expected (Tambychik&Meerah, 2010). Sometimes encountered students who have learning difficulties. Learning difficulties can be interpreted as a condition in a learning process that is marked by certain obstacles to achieve learning outcomes (Sulistyorini, 2018). According to Soedjadi, students' difficulties can be seen from their errors (Mirna, 2018). Mathematical learning outcomes are one indicator of the success of a student, school and educational world (Zulfa, Saputro, &Riyadi, 2018). The low learning outcomes of mathematics are influenced by many factors. Student errors in solving mathematical problems include one of the factors in it, thus errors need to be analyzed with the aim of getting information about these types of errors and ultimately helping students overcome difficulties in learning mathematics. Learning difficulties of students in solving math problems can be seen from the existence of problem solving errors.

According to Watson there are 8 categories of errors in solving problems, namely: a) *Inappropriate Data/ID* is students are wrong in entering data; b) *Inappropriate Procedure/IP* is that students do not understand the purpose of the problem; c) *Ommited Data/OD,* namely losing one or more data from student responses; d) *Ommited Conclusion*/OC is students are wrong in concluding a problem; e) *Response Level Conflict/RLC,* namely the response level conflict; f) *Undirected Manipulation/UM* is a correct answer with very simple reasons and illogical or random pouring; g) *Skills Hierarchy Problem/SHP* is students are not careful in doing calculations and in the calculation results; h) *Above Other/AO* is writing wrong data and does not respond (Winarsih, Sugiarti, &Khutobah, 2015). In this study Watson's criteria that have been described above will be used to analyze the errors made by students in solving the given problem. In order to help children with difficulty learning mathematics, it is necessary to know the difficulty of learning mathematics.

According to Van Hiele, there are three main things to study geometry, namely a long enough time, teaching material and teaching methods applied (Malik, 2011). Statistics show that difficulties in teaching and learning mathematics, geometry in particular, have resulted in failure in examinations (Adolphus, 2011). Based on the results of the national junior examination in Indonesia showed that the of material geometry experiencing declining late in the 3 years (Riastuti, Mardiyana, and Pramoedya, 2017). These result indicate that student make many errors in solving geometry problems.

Based on the explanation above it can be concluded that the analysis of student errors in solving mathematical communi-cation problems can be used as a good alternative and can be useful in improving mathematics learning, especially in the subject matter of the geometry of triangles and square. So that future teachers can use more appropriate strategies in learning related to triangular and square problems.

METHOD

This research is a qualitative descriptive study. This research was carried out in a junior high school in Subang in class VII 2018/2019 with 32 students. Samples were selected by purposive sampling technique. This technique is a data source sampling technique with certain considerations (Ethics, Musa, &Alkassim, 2016). In this study the first step taken by the researcher is to plan, then carry out after the implementation process is complete and obtain data, then the data is identified. The instrument used in this study is form 6 pieces about test mathematical communication ability with materials triangular and square shape of the description that has been validated by the faculty of Mathematics and one teacher math.

Analysis of the data used in several ways one of which is to reduce the data, this is done to expose the students errors in solving about communication skills mathematically based Watson error category, besides the data presented from the results of the test. After the analysis step has been done that is where it can be seen in any category that causes students to make errors in solving the problem.After step analysis above has done, it can be deduced about what causes students to make errors in solving the problem.

RESULTS

Based on the student answer sheet for each mathematical communication test question in the form of a given description, from 6 questions, for 32 students found several errors. These errors will be presented as follows:

Error Category	Question Number					
	1 Org/%	2 Org/%	3 Org/%	4 Org/%	5 Org/%	6 Org/%
ID	3/9,37%	4/12,5%	3/9,37%	1/3,12%	0	0
IP	7/21,87%	6/18,75%	15/46,87%	0	8/25%	3/9,37%
OD	4/12,5%	4/12,5%	4/12,5%	1/3,12%	4/12,5%	2/6,25%
OC	4/12,5%	5/15,62%	9/28,12%	7/21,8%	4/12,5%	5/15,62%
RLC	2/6,25%	0	0	0	0	1/3,12%
UM	2/6,25%	2/6,25%	1/3,12%	2/6,25%	0	1/3,12%
SHP	0	2/6,25%	9/28,12%	2/6,25%	5/15,62%	3/9,37%
AO	12/37,5%	13/40,62%	10/31,25%	8/25%	23/71,87%	19/59,37%

For question number 1, it appears that the most errors students make are in *AO*. The number of students who experienced errors in that category was 12 students (37.5%), while for errors in *ID* as many as 3 students (9.37%), errors in *IP*as many as 7 students (21.87%), errors in OD as many as 4 students (12.5%), errors in OC as many as 4 students (12.5%), error in *RLC* of 2 students (6.25%), errors in *UM* of 2 students (6.25%), and no students were wrong in the *SHP*category .

In problem number 2 it appears that the most errors students make are in the *AO* category. The number of students who experienced errors in that category was 13 students (40.62%), while for errors in the *ID* category were 4 students (12.5%), errors in the *IP* category were 6 students (18.75%), errors in *OD* category was 4 students (12.5%), errors in the OC category were 5 students (15.62%), errors in the *UM* category were 2 students (6.25%), errors in the *SHP* category were 2 students (6, 25%), and there are no students who are wrong in the *RLC* category .

In question number 3 it appears that the most errors students make are in the *IP* category. The number of students who experienced errors in that category was 15 students (46.87%), while for errors in the *ID* category were 3 students (9.37%), errors in the *OD* category were 4 students (12.5%), errors in OC category as many as 9 students (28.12%), errors in the *UM* category were 1 student (3.12%), errors in the *SHP* category were 9 students (28.12%), errors in the *AO* category were 10 students (31, 25%), and there are no students who are wrong in the *RLC* category .

In question number 4 it appears that the most errors students make are in the *AO* category. The number of students who experienced errors in that category was 8 students (25%), while for errors in the *ID* category were 1 student (3.12%), errors in the *OD* category were 1 student (3.12%), errors in the OC category as many as 7 students (21.8%), errors in the *UM* category were 2 students (6.25%), errors in the *SHP* category were 2 students (6.25%), and there were no students who were wrong in the IP and *RLC* categories .

In question number 5 it appears that the most errors students make are in the *AO* category. The number of students who

experienced errors in that category was 23 students (71.87%), while errors in the *IP* category were 8 students (25%), errors in the *OD* category were 4 students (12.5%), errors in the OC category were 4 students (12.5%), errors in the *SHP* category were 5 students (15.62%), and there were no students who were wrong in the ID, *RLC* and *UM* categories .

In question number 6 it appears that the most errors students make are in the *AO* category. The number of students who experienced errors in that category was 19 students (59.37%), while errors in the *IP* category were 3 students (9.37%), errors in the *OD* category were 2 students (6.25%), errors in the category OC were 5 students (15.62%), errors in the *RLC* category were 1 student (3.12%), errors in the *SHP* category were 1 student (3.12%), and there were no students wrong in the ID category.

From the table above illustrates what errors students make in solving mathematical communication problems with triangles and square material. To deepen information related to the types of students' errors based on the Watson category, in answering these questions, the following author presents an overview related to the questions, student answers and types of student errors.

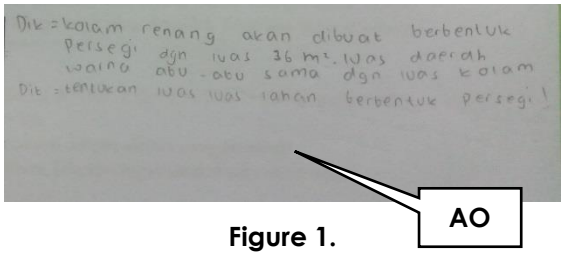

Figure 1.

The type of error is in the category *AO*. Where the errors of these students are not included in the seven categories above are grouped in this category. Errors included in this category include not responding to the questions given. It appears in the picture above that students only write things that are known in the problem and do not write answers.

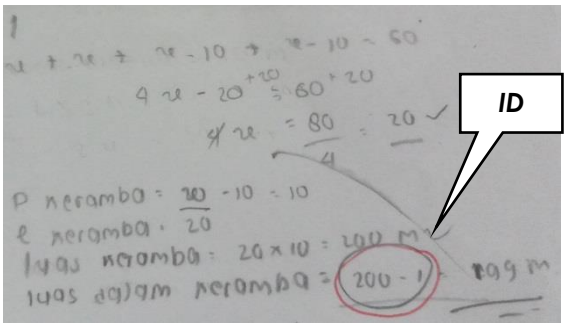

Figure 2.

The type of error is in the category *I*D. Where students try to operate the right level of a problem but choose an incorrect information or data. As in the picture above, students are asked to determine the area of the cage in which each edge is made of 1 m wide. However, students incorrectly used the data, namely the length of the cage and the width of the cage that were incorrect. Thus, the results of student work become wrong.

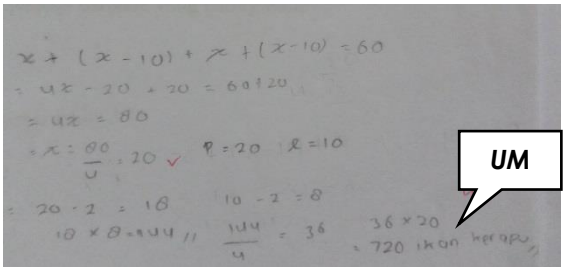

Figure 3.

The type of error is in *UM* category. On question 2, students were asked to specify what is the maximum group ercan

be main-tained, if an area of 4 m can only be charged with the 20 fish grouper. After checking, students get the correct results, which are 720 groupers. It turns out that the process to get these results is not logical or random, because students do not write clearly what is first sought. So that the reasons are not ordered but conclusions are obtained and in general all data is used. This symptom is observed as indirect manipulation.

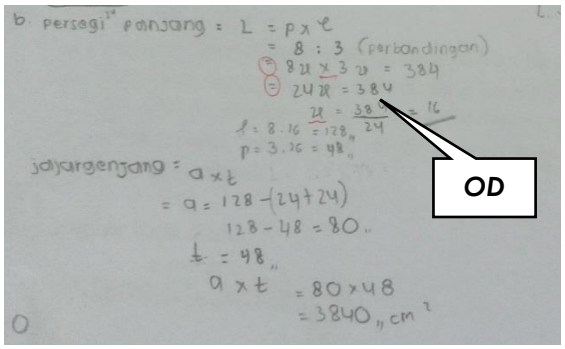

Figure 4.

The type of error is in the *OD* category. Where students do not find the right information but still try to operate the right level of a problem. So the settlement becomes incorrect. As shown in the picture above, students will look for the x value to get the length and width of the square garden. In the process of work, students have written the formula for the area of a square area to the working procedure by substituting the value of the ratio of the length and width correctly and correctly. However, in the middle of the process, the students skipped the rankof the variables into the calculation process, it should be 24 x, while the students write 24 x only. This causes students to not get the right answer because there is data missing.

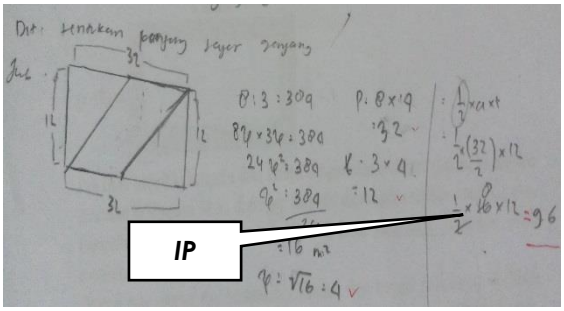

Figure 5.

The type of error is in *IP* category. Where students try to operate the right level on a problem but students use procedures that are not right. Shown in the picture above, students are asked to determine the area of land to be planted with corn, where the land is in the form of jajargenjang. Students know the formula area of the distance area, but the procedure or how to use the formula is not appropriate because students miss a data that is students find the area of the distance area by finding the area of a triangle first, but the student does not count the other triangles. So the answers obtained are notright.

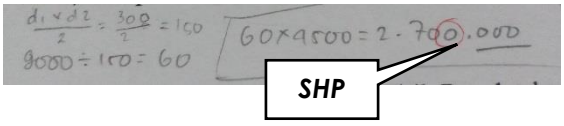

Figure 6.

The type of error is in the *SHP* category. Mathematical questions that are given require a lot of skills to be able to solve them such as skills that involve the ability to use algebraic ideas. If student skills in algebra do not emerge, askill hierarchy problem occurs. In this problem, students area sked to determine the maximum number of kites that can be made from 9000 cm paper. It appears on the student answer sheet above, that students know

the formula of the area of the kite and how to solve it. However, when going to calculate the costs obtained if all the kites were sold out, students are not careful in doing calculations. This makes the calculation results to be incorrect.

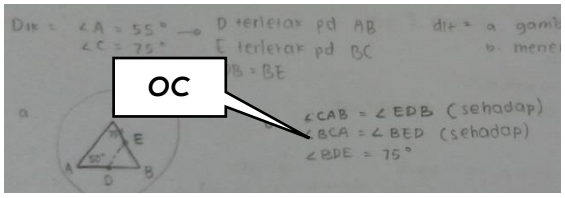

Figure 7.

The type of error is in the category of OC. Based on the student answer sheet above it appears that students in completing the given questions have not reached the final stage of what the questions ask for. The questions given are then interpreted by students in the form of the picture above, but students show conclusions at the right level of the picture then fail to conclude that the AC side and the DE side are not aligned so the angles are not the same.

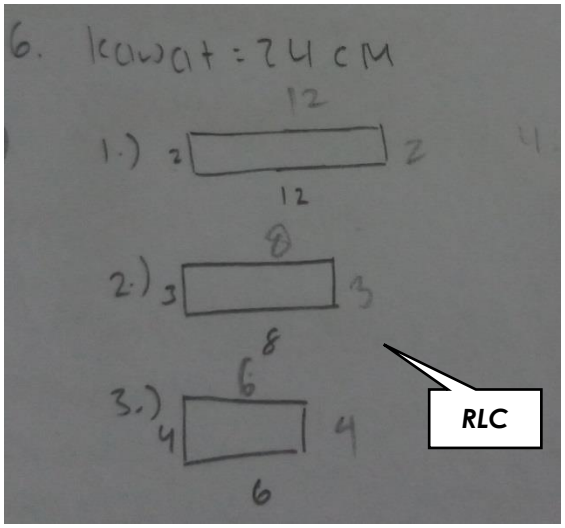

Figure 8.

The type of error is in the category of *RLC*. In this conflict of responses students seem to lack understanding of the form of the questions, so what is done is to do a simple operation with existing data which is then used as the final result in a way that is not in accordance with the actual concept. Can be seen on the answer sheet of students above, these students simply write the answer directly without any welds or logical methods. So students fail to infer the area of the largest squarearea.

DISCUSSION

In the process of mathematics learning in the classroom, evaluate the results of the students' work is very was needed. Student responses to similar questions certainly produce a variety of answers. This situation can result in errors made by students. Thus from the results of the research described above that the errors made by students have been categorized according to the Watson category, it will be easier for teachers to evaluate student learning outcomes and can improve the quality of learning in order to minimize errors made by students.

Based on the responses of 32 students to question the description given 6 obtained an average error in the category *ID* is 5.72%. This shows that the error category is very low, this percentage category is in line with the classification according to (Winarsih et al., 2015), that if the percentage is less than or equal to 20% then it is included in the very low error rate. The reason students make errors in this incorrect data category is students forget the formula used to answer the problem, students forget how to operate it, students

misinterpret questions, so students enter data incorrectly in their answer.

From the results the percentage of error in the category of *IP* obtained average is 20.31%. This percentage category is included in the very low error rate. The reason students make these errors is students do not sort the data, do not understand how to answer it, and students do not understand the purpose of the questions.

From the results the percentage of error in the category *OD* obtained the average is 9.89%, the average error in the category OC is 17.69%, the mean average error in the category *RLC* is 1.56%, the average error in the category of *UM* is 4.16%, theaverage error in the category of the *SHP* is 10.93%. This percentage category is included in the very low error rate. As for the percentage of error in the *AO* is 44.26%. Where based on the same classification is in the category of a very high error rate.

From the largest percentage on each question, common errors made by students is an error on the category *AO*. The reason students make errors other than the seven categories above is students are confused about what way to use and instead of not being filled in, and not writing answers.

CONCLUSION

Based on the results and discussion of the data obtained in the study, the following conclusions can be drawn.

1) Type students' errors in solving mathematical communication by categories according to Watson error is *ID* occurs in about 1, 2, 3 and 4. *IP*occurred in questions number 1, 2, 3, 5 and 6 .*OD* occurs in about 1, 2, 3, 4, 5 and 6. *OC*occurs at all about the numbers. *RLC*occurs in about 1 and 6. *UM*occurs in about 1, 2, 3, 4 and 6. *SHP*occurs in about 2, 3, 4, 5 and 6. *AO* occurred on all the numbersmatter.

2) The percentage of these types of errors in the category *ID* obtained an average error on was 5.72%. Errors in categories *IP* obtained an average of 20.31%. The error in the category of *OD* obtained an average of 9.89%. The results in the category of OC obtained an average of 17.69%. Errors in the category of *RLC* obtained the average is 1.56%. Errors in the category of *UM* obtained an average of 4.16%. Errors in the category of *SHP* obtained the average was 10.93%. As for the results of the percentage of errors in categories *AO* is44.26%.

3) Of the largest percentage of each question, errors that are often made by students are errors in categories *above other/AO*. The reason students makeerrors other than the seven categories above is students are confused about what way to use and instead of not being filled in , and not writinganswers.

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