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ERRORS OF STUDENTS LEARNING WITH REACT STRATEGY IN SOLVING THE PROBLEMS OF MATHEMATICAL REPRESENTATION ABILITY

Delsika Pramata Sari[1], Darhim[2], Rizky Rosjanuardi[2]

[1]Universitas Lambung Mangkurat, Banjarmasin
[2]Universitas Pendidikan Indonesia, Bandung
Email: delsika.math@unlam.ac.id

Abstract

The purpose of this study was to investigate the errors experienced by students learning with REACT strategy and traditional learning in solving problems of mathematical representation ability. This study used quasi experimental pattern with static-group comparison design. The subjects of this study were 47 eighth grade students of junior high school in Bandung consisting of two samples. The instrument used was a test to measure students' mathematical representation ability. The reliability coefficient about the mathematical representation ability was 0.56. The most prominent errors of mathematical representation ability of students learning with REACT strategy and traditional learning, was on indicator that solving problem involving arithmetic symbols (symbolic representation). In addition, errors were also experienced by many students with traditional learning on the indicator of making the image of a real world situation to clarify the problem and facilitate its completion (visual representation).

Keywords: Errors, REACT Strategy, Problems of Mathematical Representation Ability

Abstrak

Tujuan studi ini untuk menyelidiki kesalahan yang dialami siswa yang memperoleh pembelajaran dengan strategi REACT dan pembelajaran tradisional dalam menyelesaikan soal-soal kemampuan representasi matematis. Penelitian ini menggunakan pola kuasi eksperimen dengan static-grup comparison design. Subjek penelitian ini sebanyak 47 siswa SMP kelas VIII di Bandung yang terdiri dari dua sampel. Instrumen yang digunakan adalah tes, berupa soal kemampuan representasi matematis. Koefisien reliabilitas soal kemampuan representasi matematis adalah 0,56. Kesalahan yang paling menonjol dari kemampuan representasi matematis siswa yang memperoleh pembelajaran dengan strategi REACT dan pembelajaran tradisional, yaitu pada indikator penyelesaian masalah dengan melibatkan simbol aritmatik (representasi simbolik). Selain itu, kesalahan yang juga banyak dialami siswa yang memperoleh pembelajaran tradisional pada indikator membuat gambar dari situasi dunia nyata untuk memperjelas masalah dan memfasilitasi penyelesaiannya (representasi visual).

Kata kunci: Kesalahan, Strategi REACT, Soal-soal Kemampuan Representasi Matematis

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In mathematics, the mathematical representation is very important in simplifying and solving problems mathematically. Kilpatrick, Swafford, & Findell (2001) state requires mathematical representation. Because mathematics is abstract, students need access to the mathematical ideas and it can only be done through represent those ideas. National Council of Teachers of Mathematics, or commonly abbreviated by the NCTM (2000) suggested that the way mathematical ideas represented a very fundamental thing for a person so that they can understand and use these ideas. This means that the representation is a tool to convey ideas of mathematical problem solving. In addition, the representation of the argument can be used to facilitate and support the conclusions (Pape & Tchoshanov, 2001).

Seeing the importance of the role of mathematical representations in students' mathematical abilities intact. This is contradictory with the results of students' mathematical literacy Indonesia based on the study of the Programme for International Student Assessment (PISA) in 2015 by the Economic Cooperation and Development or OECD (2016), Indonesia's position compared to other countries in mathematical literacy can be said to be less encouraging. Based on the PISA 2015 report by the OECD (2016), the position of Indonesia one level below Peru. In fact, based on the PISA 2012 report the position of Indonesia is one level up Peru (OECD, 2014). However, the mean score of students Indonesia in 2015, up 11 points from 2012, respectively 386 and 375 (OECD, 2016; OECD, 2014).

In connection with the foregoing, the questions PISA uses nonroutine problems very often involves the representation of mathematical objects and situations (OECD, 2014). This indicates that the ability of students' mathematical representation of Indonesia is still low. Low ability students due to lack of representation of students' mathematical understanding, so the impact on the lack of ideas on mathematical problems. The lack of ideas on mathematical problems impacts the lack of translation of the ideas in the form of mathematical objects. Low mathematics achievement based on the PISA 2012 and 2015 on the ability of the mathematical representation of course caused by the fault of students in resolving problems PISA. According to the conclusions of Sarwadi & Shahrill (2014) states that the errors and misconceptions due to the failure in establishing a relationship between knowledge. Errors students are very important to be studied because of the impact that can last a long time if not addressed through the guidance of teachers. Errors students can be utilized to produce a diagnosis in order to improve students' cognitive structure.

Some of the research literature that examines the "error analysis" (Sarwadi & Shahrill, 2014; Farida, 2015; Rokhimah, Suyitno, & Sukestiyarno, 2015) saw the error of students in resolving problems on a certain matter. In contrast to this study, which focuses on students' mistakes in resolving problems of mathematical representation ability. The mathematical representation ability that is measured in this study include the ability to represent the cognitive activity according Mudzakir (2006) through: (1) a visual representation (making the image of a real world situation to clarify the problem and facilitate its completion), (2) a verbal representation (answer the question using words or written text), and (3) a symbolic representation (solving problem involving arithmetic symbols).

Through strategy and the proper guidance, students can get out of the problem in an effort to master mathematical concepts. Ashlock (2002) suggests teachers can develop a strategy that will be used by students to reflect an understanding. One of several alternative learning strategies that can be used is REACT strategy. REACT strategy is a learning strategy that is based on constructivism. Within the CORD (2012) mentioned that REACT strategy is based on the teaching contextual learning strategy which is structured to encourage the involvement of students in the classroom. REACT is an acronym of Relating, Experiencing, Applying, Cooperating, and Transferring.

REACT strategy can be used by teachers to train students' mathematical representation ability. According to the Center for Occupational Research and Development or CORD (1999), students enrich the basis for understanding the concept of learning with hands-on activity (experiencing). This is in line with the statement of Pape & Tchoshanov (2001), which states how to improve students' representational thinking are (1) students' exploration of alternative ways of mathematical inquiry and reasoning, (2) engaging students in hands-on and minds-on activity in the process interpreting and communicating mathematical ideas, (3) students' construction and co-construction (i.e., within social interaction) of non-standard multiple representations of problem solving and proof techniques, and (4) students' understanding of harmonic relationship between different forms of multiple representation of mathematical knowledge. The facts which gave rise to the purpose of this study, which is to investigate the errors experienced by students learning with REACT strategy and traditional learning in solving problems of mathematical representation ability.

METHOD

This study uses quasi-experimental pattern with static-group comparison design, where no research group is assigned to the two treatment groups and a posttest, but no pretest (Gall, Gall, & Borg, 2003). The subjects of this study were 47 eighth grade students of junior high school in Bandung consisting of two samples: students in the experimental class received learning with REACT strategy amounted to 23 people, while the students in the control class received traditional learning amounted to 24 people. Both samples have the same character. The control class acquires traditional mathematics learning because it is generally applied in Indonesia (Jupri, Drijvers, & van den Heuvel-Panhuizen, 2014). For example the teacher explains the concepts of mathematics, giving examples and exercises, while students pay attention, take notes, and do the exercises. The instrument used is a test to measure students' mathematical representation ability. The reliability coefficient of the items is 0.56 which belong to the medium reliability level.

Activity of learning implementation in accordance with learning plan for each class 10 times meeting. Furthermore, posttest is done for data collection and reveals errors experienced by students in solving problems of mathematical representation ability. Posttests performed on both classes use the same mathematical representation ability items. Time given during posttest for 60 minutes.

RESULT AND DISCUSSION

After the implementation of learning in the classroom with REACT strategy (REACT) and traditional learning (TL), followed by doing posttest. Errors experienced by students in solving problems of mathematical representation ability were analyzed from posttest result based on indicator mathematical representation ability that was studied. It can be seen in Table 1.

Table 1. Recapitulation of student errors in solving problems of mathematical representation ability (in %)

	Indicator	Number	REACT	TL
Mathematical Representation Ability	1. Making the image of a real world situation to clarify the problem and facilitate its completion	1a	4.35	4.17
		1b	13.04	66.67
	2. Answer the question using words or written text	2	21.74	29.17
	3. Solving problem involving arithmetic symbols	3	47.83	91.67
		$\bar{X}$	21,74	47,92
		x_{max}	12	8
		x_{min}	3	1

Based on Table 1, students who experienced error on number 1a who received learning with REACT strategy (4.35%) were higher than students who received traditional learning (4.17%). On the basis of that percentage, it does not mean that many students are learning with REACT strategy that experience more mistakes than students who have received traditional learning. In fact, the number of students who experience errors in each class is only 1 person. Problem number 1a is about the net of cube.

Item about the mathematical representation ability that is considered difficult by students is number 1b. Problem number 1b is a contextual question that provides information that a decorative lamp cube with a edge length of 25 cm and the size of one sheet of transparent paper available in the store is 120 cm × 90 cm. The question asks how many decorative lamps can be made with one sheet of transparent paper. The idea of this problem is to use the formula of the surface area of the cube to solve the given problem. In this problem students have difficulty to get ideas and what formulas should be used to solve the problem. Students who experienced error about number 1b who obtained learning with REACT strategy as much as 13.04%, while students who obtained traditional learning 66.67%. Error on problem 1b experienced by many students who obtained traditional learning. This is in line with research Farida (2015) which states that solving contextual problems is a difficulty that many students experience.

Item number 2 is about the volume of cube. Indicator about the number 2 is answer the question using words or written text. Problem number 2 is considered difficult for students because it is a contextual problem that does not mention the purpose of problem solving with straightforward. This item deals with the volume of cuboid or rectangular prism. Students who experienced error about number 2 who received learning with REACT strategy as much as 21.74%, while students who received traditional learning 29.17%.

It is a matter of mathematical representation ability which is considered to be next difficult is number 3 concerning the surface area of pyramid. Before getting an answer on the surface area of the pyramid, students must solve the problem by knowing the concept of Pythagoras, square area, and

triangle area. Students who experienced error about number 3 who obtained learning with REACT strategy as much as 47.83%, while students who received traditional learning 91.67%. The mean percentage of student error in solving problems of mathematical representation in students who obtained learning with REACT strategy (21.74%) was lower than students who obtained traditional learning (47.92%). This is in line with the maximum score and minimum score of the posttest result of the mathematical representation ability of students learning with REACT strategy higher than students with traditional learning (see Table 1).

Furthermore, based on Table 1, it can be seen that the mean percentage of students' error that learning with REACT strategy is lower than students learning with traditional learning. This means that REACT strategy can be used by teachers to train students' mathematical representation ability. This is because students who learning with REACT strategy are actively involved in learning to construct their knowledge. When learning takes place, if they have difficulty in working on the problem given through the work sheet, students without hesitate to ask the teacher and his friend. Because of this involvement, all the difficulties experienced by students who learning with REACT strategy more quickly resolved and straightened out by the teacher.

Implementation of REACT strategy according to CORD (1999) can make students enrich the basic understanding of the learning concept with hands-on activity (experiencing). This is also in line with the statement of Pape & Tchoshanov (2001) to improve students' representational thinking, namely (1) students' exploration of alternative ways of mathematical inquiry and reasoning, (2) involving students in hands-on and minds-on activity in the process of interpreting and communicating mathematical ideas, (3) students' construction and co-construction (i.e., within social interaction) of non-standard multiple representations of problem solving and proof techniques; and (4) students' understanding of harmonic relationship between different forms of multiple representation of mathematical knowledge.

In addition to analyzing student errors in general, there are interesting things to note, namely misconception. Misconceptions are error about concept that students believe to be correct in problem solving. The misconceptions found in the classes learning with REACT strategy and traditional learning are outlined below.

1. Problem number 2 on black forest cake with two different size options. The first cake measuring 31 cm x 20 cm x 10 cm and the second cake measuring 38 cm x 25 cm x 10 cm. Based on the size of the cake served, it can be deduced that the cake shaped cuboid. A small percentage of students (12.5%) who obtained traditional learning does misconception by writing the formula to find the volume of cake = $s \times s \times s$ (s = edge length). This means the edge length of all the same. However, the solution the problem until the answer is finally correct. This occurs only in students who learning with traditional learning and do not occur in students who learning with REACT strategy.

2. The misconceptions that occur in the writing of symbols *a* and *A*, where *a* in the context of problem solving means the length of triangle base, while *A* means the area of base of.

After the exposure of student misconceptions, further discussed about the mistakes experienced by students in solving problem of mathematical representation ability. Error done by student on problem 1b, write the final result 2.88 decorative lamp. Basically student answers are correct when viewed from the results of calculation alone. However, students need the reasoning ability to get the conclusion that the expected answer is 2 decorative lamps. In addition, the student's error is to write the unit for the volume of solid, which is cm^2 which should be cm^3. Write down the unit for the surface area of solid, i.e. cm which should be cm^2. Errors when writing the naming of vertices and faces, ie using lowercase letters. There are also students who use lowercase and uppercase letters simultaneously. Furthermore, the errors found in the student's answer, i.e. $3a \times 3a = 9a$.

Based on the data above, the most prominent error of mathematical representation ability namely was on indicator that problem solving involved arithmetic symbols. Basically, using arithmetic symbols is a difficulty most often experienced by students. This is in line with the study of Jupri, Drijvers, & van den Heuvel-Panhuizen (2014). In the study, it was mentioned that algebra has been widely recognized as one of the most difficult topics, leading to learning difficulties worldwide. Because basically, one of difficulties in algebra due to the many use of arithmetic symbols (Aziz, Pramudiani, & Purnomo, 2017; Syamsuri, et al. 2017; Nurhasanah, Kusumah, & Sabandar, 2017). The higher the percentage of error is the more difficult the problem.

CONCLUSION

The research question in this study concerns errors experienced by students learning with REACT strategy and traditional learning in solving problems of mathematical representation ability. From this study's data, we conclude that the most prominent error of mathematical representation ability on indicator that problem solving involved arithmetic symbols (symbolic representation). The error is about the concept of the prism surface area that involves symbols and needs to solve the problem by applying the concept of Pythagoras, triangle area, and square area. In addition, errors are also experienced by many students with traditional learning on the indicator of making the image of a real world situation to clarify the problem and facilitate its completion (visual representation), i.e. the concept of the cube surface area with contextual problems.

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