



The Effect of the Application of the 5E Learning Cycle Model on Mathematical Communication Skills in Junior High School Students

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ABSTRACT

This research is motivated by the low students mathematical communication skills. To overcome this problem is by improving the learning process that provides opportunities for students. One of them is by applying the 5E Learning Cycle model. The 5E Learning Cycle model is a series of activities so that students can master the competencies achieved in learning by taking an active role, directed to seek and discover new knowledge themselves. The research is to investigate the impact of the application of Learning Cycle 5E on mathematical communication skills in terms of overall, ability level and, interaction between learning model and ability level. This research is a quasi-experimental study with a pretest post-test control design. The results of data analysis show that the mathematical communication skills of students who learn using the 5E learning cycle model are better than students with conventional learning. For students mathematical communication skills at the moderate level, the 5E learning cycle model is better, but not better for high and low levels. There is no interaction between the learning model and ability level of mathematical communication skills.

1. Introduction

Mathematics as a discipline cannot be separated from the world of education, especially in the development of science and technology. Given the importance of mathematics in science and technology, it is only natural that mathematics as one of the compulsory subjects needs to be mastered properly by students. School mathematics lessons not only emphasize algorithmic abilities, but also teach students to be able to communicate and relate various mathematical ideas in everyday life. Mathematics learning should not only include mastery of algorithmic mathematical concepts, but also applied mathematical skills such as

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presenting, analyzing, and interpreting data, and communicating it is very necessary.

In line with the above statement, Permendikbud Number 58 of 2014 concerning the 2013 Curriculum states that one of the objectives of learning mathematics is to communicate ideas, reasoning and be able to compile mathematical evidence using complete sentences, symbols, tables, diagrams, or other media to clarify the situation or problem. From the objectives of the mathematics subject, it can be seen that communication skills are one of the aspects of mathematics skills that are important to be mastered by students. Through good communication skills students are able to communicate ideas, reasoning and be able to compile mathematical evidence using complete sentences, symbols, tables, diagrams, or other media to clarify a situation or problem.

Rahmawati (2016) stated that the Trend In Mathematics and Science Study (TIMSS) survey in 2015 mathematics achievement in Indonesia was in 45th place out of 50 countries with a score of 397. In addition, Indriani (Astuti et al., 2018) stated that the survey conducted by the Organization for Economic Cooperation and Development (OECD) in 2015 using the Program for International Student Assessment (PISA) test that Indonesia's mathematics achievement is ranked 64th out of 72 countries. This data shows that mathematics is still very low in Indonesia. This shows that math skills are still very low in Indonesia.

To measure and evaluate students' abilities, the Ministry of National Education uses the National Examination (UN) system. In the 2017/2018 National Examination, questions that require high reasoning power have been implemented. Because Indonesian students are still weak in High Order Thinking Skills (HOTS), such as reasoning, analyzing and evaluating (Kemendikbud, 2017). In this case, it is necessary to habituate daily class assessments by working on HOTS questions so that students get used to building their mathematical abilities. This is also needed to improve the quality of the UN.

The importance of mathematical communication skills is also explained by Asikin (Umar, 2012), which is to help students sharpen their thinking, as a tool to assess student understanding, help students build their mathematical knowledge, improve their mathematical problem solving abilities, advance their reasoning, build self-efficacy, improve their social skills, as well as being useful in establishing a mathematical community. Students who are able to analyze, give reasons and communicate their cognitive knowledge and mathematical concept skills effectively are those who have mathematical literacy skills (Sumarmo, 2017a; Sumarmo, 2017b), so that in the process of learning mathematics, students directly learn to reason and analyze a situation and need to communicate his ideas.

Greenes and Schulman (Umar, 2012) state that mathematical communication is: (1) a central force for students in formulating mathematical concepts and strategies, (2) success capital for students on approaches and solutions in mathematical exploration and investigation, (3) a platform for students communicate with their friends to obtain information, share thoughts and findings,

brainstorm, assess and sharpen ideas to convince others. This shows that mathematical communication skills are important in helping students to organize their thinking processes. The above statement shows that communication skills can be built in the learning process. This means, to build communication skills the teacher must be able to create a learning atmosphere that encourages students to communicate mathematical ideas. Sumarno (Marlina, et al, 2014) states that to develop mathematical communication skills, it can be done by fostering cooperation and respecting the opinions of others, students can be given learning assignments in small groups.

Communication is a very important part of mathematics. As stated by Clark (Asikin, 2013) communication is a way of sharing ideas and clarifying understanding. Through communication ideas can be reflected, refined, discussed and developed. The communication process also helps to build meaning and make ideas permanent and the communication process can also explain ideas. When students are challenged about their thinking and thinking skills about mathematics and communicate the results of their thoughts orally or in writing, they are learning to explain and convince.

According to Baroody (Wahid, 2012) there are at least two important reasons that make communication in learning mathematics the focus of attention, namely mathematics is not only a thinking aid, a tool for finding patterns, or solving problems but mathematics is also a social activity in learning mathematics. interaction between students, as well as teacher-student communication. The indicators of mathematical communication skills measured in this study are (1) explaining an idea or situation from a picture or graphic in their own words in writing (writing), (2) stating a situation with a picture or graphic (drawing) and (3) states a situation in the form of a mathematical model (mathematical expression).

According to Cai and Patricia (Hutapea, 2013) teachers can accelerate the improvement of students' mathematical communication by giving various variations of mathematics assignments. Mathematical communication plays an effective role when the teacher conditions students to listen actively. Therefore, changing the viewpoint of learning from teaching teachers to learning students must become the main focus in any mathematics learning activity. The reality in the field shows that learning activities are still dominated by teachers. Many students find it difficult to interpret mathematical symbols into mathematical sentences. This shows that students' communication skills are still weak.

The role of the teacher as one of the determinants of learning success which plays an important role, should have extensive knowledge, can create a learning atmosphere that encourages students 'desire to develop students' thinking skills. The teacher must also give students the opportunity to express ideas, respond to their friends' ideas and compare their ideas with friends in an effort to develop their communication skills.

Efforts to improve the learning process, preferably through the selection of appropriate and innovative learning models in mathematics learning. The learning model that is thought to improve process quality and mathematical communication skills is the 5E learning cycle model. The 5E learning cycle learning model is a student centered learning model which is a series of activity stages or phases that are formed in such a way that students can master the competencies that must be achieved in learning by taking an active role, directed to seek and discover for yourself a new knowledge. (Asmawati & Wuryanto, 2014). The 5E learning cycle model has 5 learning phases, namely engagement (generating interest), exploration, explanation, elaboration, and evaluation.

The 5E learning cycle model empowers students to take responsibility and construct their own knowledge, put forward their ideas, so that they are motivated to be active while learning. In each step of the learning cycle the 5E model reflects the interaction between students and teachers, as well as interactions between students. Especially at the explanation stage, students communicate the results of their observations and understanding.

The fact of the application of the 5E learning cycle is reinforced by the results of research by Agustyaningrum (2011) which shows that learning mathematics using the 5E learning cycle model can be used by teachers as an alternative way to improve students' mathematical communication skills. In addition, Agustyaningrum (2011) also shows that learning mathematics using the 5E learning cycle model is able to make class IX B students of Junior High School 2 Sleman have good mathematical communication skills with a percentage of 69.21% reaching the high category (based on observation sheets) and 70, 11% achieved good category (based on test results).

It is believed that the implication of innate ability (the experiential ability that students already have) is believed to have a different impact on students' mathematical abilities after they receive the 5E learning cycle model. In line with this, in this study the impact of the treatment given on communication skills was also assessed based on the students' abilities which were divided into high, medium and low levels.

Based on the description above, it is important to conduct an investigation through research on the effect of the application of the 5E learning cycle model on the mathematical communication skills of students of Junior High School in Pekanbaru. The formulations of the problems in this study are: (1) Is the mathematical communication ability of students of Junior High School in Pekanbaru who learn using the 5E learning cycle model better than students who learn using conventional learning? (2) Is the mathematical communication ability of students of Junior High School in Pekanbaru better than students who learn using conventional learning in terms of student ability levels (high, medium, and low)? (3) Is there an interaction between the 5E learning cycle model and the ability level (high, medium and low) on students' mathematical communication skills?

The objectives of this study are as follows (1) To comprehensively describe the effect of the application of the 5E learning cycle model on the mathematical communication skills of students of Junior High School Pekanbaru City in the experimental class better than students who learn with conventional learning in terms of: (a) overall and (b) ability level, and (2) To comprehensively describe the interaction between the 5E learning cycle model with the level of ability (high, medium and low) on students' mathematical communication skills.

2. Methodology

This research was a quasi-experimental study, with a pretest - post-test control group design. Briefly, the research design is listed in Table 1 (Sugiyono, 2013).

Table 1. Pretest-Post-test Research Design Control Group Design

Group	Pretest	Treatment	Post-test
Experimental class	O ₁	X ₁	O ₂
Control class	O ₁	-	O ₂

Information:

O₁: Pretest of students' mathematical communication skills

O₂: Post-test of students' mathematical communication skills

X₁: 5E learning cycle model

The study population was all Junior high school students in Pekanbaru in the 2019/2020 school year. To determine the research sample, the population was grouped into three levels, namely high, medium, and low, which are based on national examination data for the 2017/2018 school year, using the following interval criteria:

High level school : Average UN score $\geq \bar{X} + 0,5s$.

Medium level school : $\bar{X} - 0,5s \leq$ Average UN score $< \bar{X} + 0,5s$

Low level school : Average UN score $< \bar{X} - 0,5s$

Note: s = Standard deviation

After determining the school level, a moderate random sampling technique was carried out to determine the research sample. With this technique, junior high school 12 Pekanbaru was chosen. In this connection, class VII junior high school 12 Pekanbaru was used as the research sample, namely 3 experimental classes and 3 control classes. The class determination technique used as the experimental class and the control class was carried out by using purposive sampling technique.

The data of this research are quantitative data obtained through written tests, namely pretest data and post-test data. The data analysis technique begins with the pretest data normality test. If the pretest data is normally distributed, then to test the research hypothesis using post-test data, but if the data is not normal, then to test the research hypothesis using the difference between the post-test data and pretest data. The data used to test the hypothesis will be subjected to prerequisite

tests, namely normality and homogeneity. After the prerequisite test was carried out, the data were tested in accordance with the test requirements of each hypothesis, namely using the t test, one-way anova test, and two-way anova test.

3. Results and Discussion

The 5E learning cycle model is a learning model that is student centered. Learning cycle 5E is a series of activity stages or phases that are formed in such a way that students can master the competencies that must be achieved in learning by taking an active role. The 5E learning cycle model is a learning model with a constructivist approach.

In the experimental class the teacher is the researcher himself while in the control class who teaches is the teacher of the subject concerned. The first meeting conducted a pretest to see the mathematical communication skills of students in the experimental class and control class through questions and questionnaires. The second meeting to the seventh meeting was the implementation of the action through the implementation of the 5E learning cycle for the experimental class. The control class is taught by conventional learning with a scientific approach carried out by field teachers in schools. The eighth meeting was carried out by posttest for the two class groups through questions and questionnaires. The learning process in the experimental class through the 5E learning cycle at the beginning of the meeting looks stiff, that is, students seem hesitant in carrying out instructions at LKPD, communication in groups looks not good and there are still many students who ask questions regarding instructions at LKPD.

At the second meeting the learning process went better. However, it hasn't run optimally. At the third meeting until the last meeting, the learning process had gone well as expected, this was seen by students starting to understand the instructions in the LKPD, there was good communication in groups and most of the students' answers to the practice questions were answered correctly. In general, students who learn through the 5E learning cycle have a positive effect on students' mathematical communication skills.

The following describes the results of research related to the formulation of research problems in order:

1. The results of data analysis of students' overall mathematical communication skills.

The facts of students' overall mathematical communication abilities are as shown in Table 2. Based on the results of the calculations contained in Table 2, it is obtained that H_0 information is rejected, which shows that significantly the mean score of mathematical communication skills of students who learn using the 5E learning cycle is better than students who learn using conventional learning, so the mathematical communication skills of students of Junior high school in Pekanbaru

are learning using the 5E learning cycle model is better than students who learn using conventional learning.

Table 2 Calculation Results of Average Difference Test in Mathematical Communication Ability

Class	N	Mean	Std Deviasi	T	Sig. (2- Tailed)	Information
Experiment	105	72,76	19,691	3,528	0,001`	H ₀ rejected
Control	105	63,47	18,473			

- The results of data analysis on students' mathematical communication skills are reviewed based on the aspects of the student's ability level.

The students' mathematical communication abilities based on the ability level are shown in Table 3.

Table 3. Calculation Results of t-test Post-test Data of Mathematical Communication Ability Based on Ability Level.

Data		N	Mean	Std. Deviasi	T	Sig. (2- tailed)	Information
High level	Experiment	36	80,33	15,069	0,798	0,428	H ₀ accepted
	Control	34	77,29	16,790			
Medium level	Experiment	37	77,51	17,798	4,159	0,000	H ₀ rejected
	Control	36	62,33	13,089			
Low level	Experiment	32	58,75	19,502	1,730	0,088	H ₀ accepted
	Control	35	51,31	15,597			

Based on the results of the calculation of the data contained in Table 3, information is obtained, (1) for high and low levels H₀ is accepted, which indicates that significantly the mean score of mathematical communication skills of students who learn with the 5E learning cycle is not better than students who learn with conventional learning , (2) for the moderate level H₀ is rejected, which indicates that the mean score of mathematical communication skills of students who learn using the 5E learning cycle is better than students who learn using conventional learning for the level of student ability, so the mathematical communication skills of students of Junior high school in Pekanbaru who learn using the 5E learning cycle model is no better than students who learn using conventional learning.

- The results of the interaction data analysis of students' mathematical communication skills.

Obtained the facts of students' mathematical communication skills related to interactions are shown in Table 4. Based on the results of the calculations contained in Table 4, it is obtained that H₀ information is accepted, which indicates that there is no interaction between the 5E learning cycle model and the level of ability on students' mathematical communication skills.

Table 4. Calculation Results of Two-Way Anova Test Data Communication Ability Post-test

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	25396.422 ^a	5	5079.284	18.939	.000
Intercept	966661.508	1	966661.508	3604.319	.000
Model	3830.758	1	3830.758	14.283	.000
Level	19689.206	2	9844.603	36.707	.000
Model * Level	1353.197	2	676.598	2.523	.083
Error	54711.845	204	268.195		
Total	1054960.000	210			
Corrected Total	80108.267	209			

The results of hypothesis testing that have been done show that the mathematical communication skills of students using the 5E learning cycle model are better than students who learn using conventional learning. This result is relevant to the results of research conducted by Priambodo, Sugiarto and Cahyono (2014) entitled *The Effectiveness of Learning Cycle Model Assisted by Teaching Aids on Mathematical Communication Ability*. The results of this study indicate that the students' mathematical communication skills in the experimental class have achieved mastery learning and the experimental class students' mathematical communication skills are better than the control class.

It is also in line with the results of research conducted by Lely Lailatus & M. Arie Firmansyah (2016) entitled *The Influence of Learning Cycle Learning Models on Students' Mathematical Communication Ability with Mathematical Beliefs*. The result of this research is that learning mathematics using the learning cycle model affects the mathematical communication skills of students who have high mathematical belief. This happens because students who learn using the 5E learning cycle model are directly involved in each stage. At the engagement stage, students are asked questions that aim to develop students' curiosity so that there is a desire for students to explore related problems given.

The exploration stage is a phase where students gain knowledge with direct experience related to the concepts being learned. The explanation stage is a phase in the 5E learning cycle model which is used to express ideas by discussing with group friends. The elaboration stage is a stage to train students to solve problems related to the concepts they have just obtained. In the evaluation stage, the teacher with students made joint corrections to the results of the work that had been done in the elaboration phase.

The third hypothesis testing shows that there is no interaction between the 5E learning cycle model and the school level on students' mathematical communication skills, meaning that each factor (learning model and school level) is not interdependent and does not influence each other. This shows that these two things (learning model and school level) have their own position on students' mathematical communication skills.

4. Conclusion

Based on the results of the research and discussion that has been stated, it can be concluded that: (1) the mathematical communication skills of Pekanbaru City Junior High School students who learn using the 5E learning cycle model are better than students who learn with conventional learning, (2) mathematical communication skills Pekanbaru city junior high school students who learn using the 5E learning cycle model are no better than students who learn with conventional learning for high and low ability levels, while the mathematics communication skills of Pekanbaru city junior high school students who learn using the 5E learning cycle model are better than students those who learn with conventional learning for moderate ability levels and (3) there is no interaction between the learning model and the ability level of mathematical communication skills.

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