Experimentation of Connecting, Organizing, Reflecting, Extending (CORE) Learning Models with PMR Approaches to Students' Mathematical Communication Skills

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Abstract. Mathematics learning has an important role to prepare students to have cognitive abilities such as problem-solving, reasoning, mathematical communication, and critical thinking. Communication is very important in every human's social life. In communicating, a person must be clear in giving meaning and language that can be understood by the interlocutor. The application of the CORE learning model with the PMR approach is a solution for training students in mathematical communication. The CORE learning model with the PMR approach is learning that enables students to build and develop their knowledge abilities which are assisted by real object constituents that are often encountered by students in daily life and then brought into mathematical form to facilitate students in developing mathematical communication skills. The purpose of this study is to analyze the mathematical communication skills of students and which are better mathematical communication skills of students from a high, medium, or low school categories.This type of research is a qualitative descriptive study. The sample was selected by using the Combined Sampling technique, namely Stratified Cluster Random Sampling. The population is divided into three categories (high, medium and low) based on the results of the previous year's national exams, then one school is chosen from each category, and then 1 class is chosen to represent the selected school. The instrument for retrieving data is essay questions as much as 2 questions and the material being taught is the chapters to build flat side spaces.Based on the results of the answers from students, it was found that the mathematical communication skills of students from high school categories were better than students from medium schools and students from low school categories.Based on the results of the analysis of the importance of communication skills in learning mathematics requires teacher training or guidance to further train and accustom students to develop mathematical communication skills. CORE with the PMR approach can train and improve students' mathematical communication skills. This is following one of the 21st-century learning objectives that require students to be more active in learning and have good mathematical communication skills.

Keywords: communication, education, level, mathematical

1 Introduction

21st Century learning is an implementation of the advances in the industrial era 4.0. Education in the 21st century reflects 4 things, namely: (1) The ability to think critically (critical thinking skills). (2) creativity (creativity). (3) communication (communication). (4)

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collaboration (collaboration). Learning mathematics in schools has an important role to prepare students to have cognitive abilities such as problem-solving, reasoning, mathematical communication, and critical thinking [1]. Although learning mathematics at every level of education, it does not mean that students master mathematics well [2]. The quality of mathematics education in Indonesia today is still not as expected both in mastering the material and students' attitudes towards mathematics.

In line with 21st-century learning goals, Communication is very important in social life [1]. In communicating, a person must be clear in giving meaning and language that can be understood by the interlocutor [3]. Mathematical communication is an important process for learning mathematics [2]. Mathematical communication has an important role in learning mathematics [4]. Mathematical communication skills are the ability of students to understand, express and explain ideas mathematically both orally or in writing [3]. Students can connect real objects/pictures or diagrams in problem-solving, express ideas into mathematical models in writing, explain ideas or solutions with their language, express mathematical ideas to the problems discussed. and bring students to a deep understanding of mathematics [4]. In Indonesia, the ability of Mathematical Communication students is still below other countries [13]. Because mathematical communication skills are not too important in learning mathematics in schools [4]. Students are not involved in learning [5]. The teacher is more concerned with results than understanding good concepts [5]. Students have difficulty using everyday language into mathematical form so that it has the potential to weaken students' ability to learn [5].

The application of the CORE learning model with the PMR approach is a solution for training students in mathematical communication. The CORE learning model is an alternative learning model that can be used to enable students to build their knowledge [11]. The CORE learning model is an abbreviation namely *connecting, organizing, reflecting, and extending* [6]. PMR approach is mathematics learning which is done by using reality as a starting point for student learning [8]. PMR approach instruction begins by bringing students into contextual issues that are well known to students [10]. The PMR approach emphasizes mathematics as a human activity that is linked in the real world context [9]. The PMR approach is intended to make learning more interesting and meaningful for students [10]. The CORE learning model with the PMR approach is learning that activates students to build and develop their knowledge abilities which are assisted by real object constituents that are often known to students and then taken to the form of mathematics to help students' mathematical communication skills.

The purpose of this study was to analyze students' mathematical communication skills and which were better mathematical communication skills of students from the high, medium, or low category schools by applying the CORE learning model to the PMR approach in class VIII of SMP Negeri in Nganjuk Regency in the 2018/2019 school year. The hypothesis of this study is the mathematical communication skills of students from high school categories are better than students from medium and low school categories.

2 Method

This type of research used in this research is descriptive qualitative research [14]. The population in this study were all students of State Junior High School in Nganjuk Regency in the academic year 2018/2019. In this study, the sample was selected by using the Combined

Sampling technique, namely Stratified Cluster Random Sampling [14]. The population is divided into three strata (high, medium and low) based on the results of the 2017/2018 national exam then one school from each stratum is selected, then 1 class is chosen to represent the selected school [14]. Class 1 is a high school category, Class II is a medium school category, and class III is low school category). The three selected classes will be subject to the application of the CORE learning model with the PMR approach.

Table 1. Sample selection results

School Name	Category	Class CORE
SMP Negeri 3 Nganjuk	High	VIII E
SMP Negeri 1 Berbek	Medium	VIII C
SMP Negeri 1 Sukomoro	Low	VIII H

Indicators of mathematical communication skills set in this research are (a) generalizing a problem into a mathematical form (b) Students can connect real objects, pictures or diagrams into mathematical ideas, (c) express ideas into mathematical models in writing, (d) explain ideas with real objects, images to find solutions in your own language.

3 Results

Based on the results of the communication skills test carried out after the sample gets the treatment model of learning obtained mathematical communication ability data as follows:

3.1 Class I (Junior High School 3 Nganjuk)

In first class, there were 32 students in class VIII E. The results of student answers are as follows:

Table 2. Results of class 1 answers to problem number 1

Problem Number 1					
Indicator Fulfilled	4	3	2	1	0
Many students	12	8	8	4	0

From **Table 2**, it was found that in class I, of the 32 students who took the Mathematical Communication Ability Test Number 1, 12 students (37.5%) were able to fulfill all indicators, 8 students (25%) fulfilled 3 indicators, 8 students (25%) meets 2 indicators, 4 students (12.5%) only meet 1 indicator.

Table 3. Results of class 1 answers to problem number 2

Problem Number 2					
Indicator Fulfilled	4	3	2	1	0
Many students	10	10	5	6	1

From **Table 3**, it was found that in class core 1, of the 32 students who took the Mathematical Communication Ability Test number 2, 10 students (31.25%) were able to meet all indicators, 10 students (31.25%) met 3 indicators, 5 students (15.6%) fulfilled 2 indicators, 6 students (18.7%) only fulfilled 1 indicator, and 1 student (3.12%) who was unable to meet the mathematical communication ability indicators.

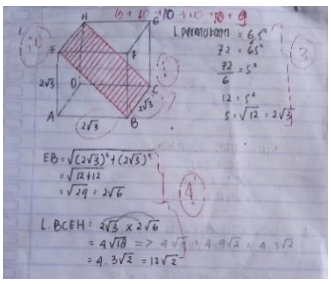

Fig 1. Example answer S1 to question no 1

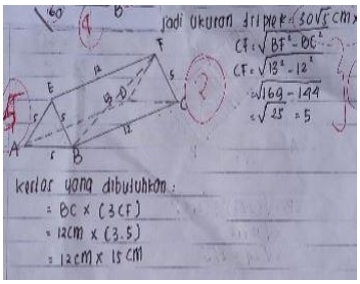

Fig 2. Example answer S1 to question no 2

S1 is a student from class 1. Figure 1.2 shows that most students can answer test questions by predetermined indicators. Students can generalize from a problem in the form of mathematics. Students can connect real objects, pictures or diagrams into mathematical ideas to solve a problem. Able to express mathematical ideas on the problem discussed. Mathematical expression, which can state the problem in a mathematical model in writing and be able to explain the idea or solution of a problem or picture using their language. So that indicators of mathematical communication skills that are expected to be fulfilled by most students. The answers from class I have fulfilled mathematical communication skills [15].

3.2 Class II (Junior High School 1 Berbek)

In class II, the number of class VIII C students was 32 students. The results of student answers are as follows:

Table 4. Results of class II answers to problem number 1

Problem Number 1					
Indicator Fulfilled	4	3	2	1	0
Many students	8	10	6	4	4

From **Table 4**, it is found that in class II. Of the 32 students who took the Mathematical Communication Ability Test number 1, it was found that 8 students (25%) were able to meet all indicators, 10 students (31.25%) met 3 indicators, 6 students (18.7%) met 2 indicators, 4 students (12.5%) only met 1 indicator, and 4 students (12.5%) students were unable to meet the indicator.

Table 5. Results of class 1I answers to problem number 2

Problem Number 2					
Indicator Fulfilled	4	3	2	1	0
Many students	8	10	10	2	2

From **Table 5**, it was found that in class II, of the 32 students who took the Mathematical Communication Ability Test number 2, it was found that 8 students (25%) were able to meet all indicators, 10 students (31.25%) met 3 indicators, 10 students (31.25%) met 2 indicators, 2 students (6.25%) only met 1 indicator, and 2 students (6.25%) were unable to meet the mathematical communication ability indicators.

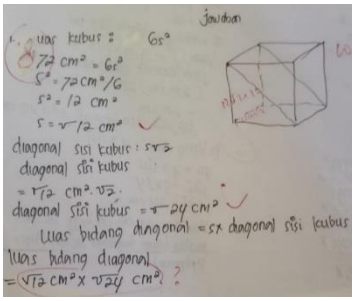

Fig. 3. S2 example answer to question no 1

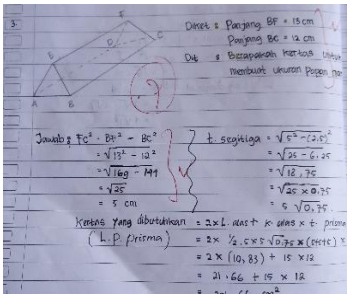

Fig. 4. S2 example answer to question no 2

S2 is a student from a medium category school. Students are able to generalize into mathematical forms, students are able to turn mathematical problems into real objects or images into mathematical ideas, students are able to explain and solve mathematical problems by using their language, but students are not able to express mathematical ideas to explain pictures or elements of images as an effort to solve the problem. [15]. In problem number 2 students are unable to find the idea that the nameplate in the form of a prism is a rectangle that is folded up.

3.3 Class III (Junior High School 1 Sukomoro)

In class III there were 25 students in class VIII H. The results of student answers are as follows:

Table 6. Results of class III answers to problem number 1

Problem Number 1					
Indicator Fulfilled	4	3	2	1	0
Many students	7	4	8	5	1

From **Table 6**, it was found that in class III, of the 25 students who took the Mathematical Communication Ability Test number 1, found 7 students (28%) were able to meet all indicators, 4 students (16%) met 3 indicators, 8 students (32%) met 2 indicators, 5 students (20%) only meets 1 indicator, and 4 students (4%) students are unable to meet the indicators.

Table 7. Results of class III answers to problem number 2

Problem Number 2

Indicator Fulfilled	4	3	2	1	0
Many students	6	6	6	4	3

From **Table 7**, it was found that in class II, of the 25 students who took the Mathematical Communication Ability Test number 2 found that 6 students (24%) were able to meet all indicators, 6 students (24%) met 3 indicators, 6 students (24%) met 2 indicators, 4 students (16%) only fulfilled 1 indicator, and 3 students (12%) were unable to meet the mathematical communication ability indicators.

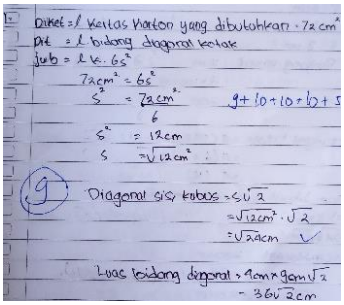

Fig. 5. S3 example answer to question no 1

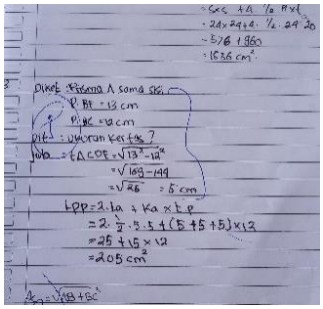

Fig. 6. S3 example answer to question no 2

S3 are students from low category schools. From the students' answers above it can be seen that students cannot connect real objects or images into the mathematical form [15]. Unable to express mathematical ideas in solving the problem [15]. Students are only able to generalize problems into mathematical form and students can solve problems with their language, but no ideas appear in the answers.

From the answers of the three classes, mathematical communication skills are considered good if they are able to meet 4 indicators and 3 indicators. So we get the following data:

Table 8. Percentage results of student communication skills

Problem Number 1			
Class	Total Students	Many Student	Percentage
Class I	32 Student	20 Student	62,5%
Class II	32 Student	18 Student	56,25%
Class III	25 Student	11 Student	44%

Table 9. Percentage results of student communication skills

Problem Number 2			
Class	Total Students	Many Student	Percentage
Class I	32 Student	20 Student	62,5%
Class II	32 Student	18 Student	56,25%
Class III	25 Student	12 Student	48%

Based on the results of the answers from students it was found that the mathematical communication skills of grade 1 students were better than grades II and III because most (62.5%) students were able to meet the specified communication skills indicators. Class II has

better mathematical communication skills than class III because 56.25% of students meet the specified indicators compared to class III by 44% and 48%.

4 Discussion

Most of the students from the medium school category (Class II) have met the expected mathematical communication skills indicator, but there are still many students who have not been able to express ideas into pictures to solve a problem. Students are only able to draw but do not understand what will be done with the picture. Students are not able to dig up information about what they write or draw [3]. Lack of practice and lack of activities that train students' mathematical communication skills are the solutions. Good learning is learning that can make students active and train students' communication skills [17]. It aims to make the students' answers clear the purpose and purpose [18].

Students from low category schools (Class III) show the ability to connect real objects or images into mathematical form is still low, students also can not express mathematical ideas to solve problems. Based on the results of the answer sheet students seem to have difficulty in connecting images or real objects to mathematical forms and some are even unable to do so. Some students write the idea of completion at will or just what students know. This happens because students are less able or not accustomed to connecting real objects into mathematical forms. It could be that the context of the problem at hand is not like what is often encountered or known by students. Besides the teacher is also not accustomed to using students' mathematical communication skills in teaching and learning is still teacher-centered [19]. Students are less active in discussions and presentations [17]. Therefore a change in learning is needed, the use of learning models and approaches in learning are expected to be able to train students' communication skills both verbally and in writing [18].

5 Conclusion

Based on the results of the analysis of the importance of communication skills in learning mathematics, teacher training or guidance is needed to train students' mathematical communication skills. Often involve students in learning. To practice communication skills is very important in learning, so that in subsequent learning educators can determine the appropriate methods and models to overcome various problems. Then, ultimately, it will have an impact on improving learning outcomes .

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