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Improving mathematical communication skills through the implementation of reasoning and problem solving model

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Abstract

The aim of this classroom action research was to improve the mathematical communication skills of 11th grade IIS students in SMAN 1 Blahbatuh. The subject of this study was 32 11th grade IIS students in SMAN 1 Blahbatuh in academic year 2017/2018. The results showed that the implementation of reasoning and problem solving learning model improved the mathematical communication skills of 11th grade IIS students in SMAN 1 Blahbatuh. The improvement could be seen from the students learning completeness that increased 6,3% from 3,1% in the first cycle became 9,4% in the second cycle and increased to be 78,2% in the third cycle. Besides that, students gave positive responses toward the implementation of reasoning and problem solving learning model with mean score 57,2. The improvement of students' mathematical communication skills happened because of reasoning and problem solving learning model gave emphasis to students through guided-questions in constructing mathematical ideas, gave more opportunities to students in delivering opinion, and gave guidance and motivation to students.

Keywords: *mathematical communication skills; reasoning; problem solving*

Introduction

The education field plays an important role in the development and the survival of a nation. In terms of needs, quality human development needs to be prepared to participate in the implementation of planned development programs to advance the development of a nation. One of the efforts to create qualified human is through education. So the quality of education is considered as an important thing to be improved.

The realization of the implementation of development in the education field is one of them with formal education in schools, where the school as one of the educational institutions which is a place of science and technology development in students before get in into the community. Various fields of science and technology are taught in schools and one of them is mathematics. In addition to the field of science, mathematics is also one of the areas of study that is very important for students and for the development of other fields of science (Suherman & others, 2003). The position of mathematics in education field has

enormous benefits as the tool in the development of education and intelligence of mind. Therefore, education in mathematics has potential to play a strategic role in preparing qualified human resources. This potential is realized if mathematics has succeeded in fostering the ability to think logically, critically, creatively, initiative, and adaptive towards changes and development. Remembering the importance of the role of mathematics in the society, the mastery of mathematics must be understood exactly and correctly.

In fact mathematics is perceived as a scourge for some students. Mathematics is considered as a difficult and unpleasant lesson, so that when going to study mathematics many students are less enthusiastic in following the learning of mathematics. The lack of students' enthusiasm towards learning mathematics will greatly affect the learning activities in the classroom, so it leads to the low ability of students' mathematical communication to the material that being taught.

One of the schools that is still facing similar problems in learning mathematics is SMA Negeri 1 Blahbatuh, especially in class XI IIS 1 in academic year 2017/2018. Based on the results of pre-observations made by researchers in class XI IIS 1 SMAN 1 Blahbatuh in July 2017, students' mathematical communication skills are still classified as less. In addition, based on interviews with the teacher of mathematics subjects Nyoman Gunarta, S.Pd, class XI IIS 1 SMAN 1 Blahbatuh in July 2017 obtained other problems besides the problems mentioned earlier are as follows: (1) Students are reluctant to convey ideas or (2) Students have not been able to communicate ideas by using complete sentences, symbols, tables, diagrams, or other media to clarify circumstances or problems, (3) Students seem afraid or hesitant to answer teacher questions, and less assertive in expressing opinion. This is obvious when students answer the question nervously, as students are not sure that the answers mentioned are true.

In addition, based on interviews with some students of class XI IIS 1 of SMAN 1 Blahbatuh, obtained the following things: (1) Students feel a lot of doubt with the answers that have been made, so that students cannot properly communicate the idea. This is also because the teacher is often less detail in discussing the solution of the questions that have been given. As the result students receive meaningless lessons, (2) Students tend to be happy to use quick formulas, as long as they get an answer without knowing the idea to solve the

problem given. In addition, there are students who think that math is useless in everyday life, (3) Students are afraid to put forward their ideas because most of the students are afraid of mistakes in answering teacher's questions. As a result, in the classroom the students seem to be passive.

After conducted observations and interviews, to further convince the researcher that in class XI IIS 1 there is a problem, and to know or to measure the extent to which the initial skill of mathematical communication in writing, the researcher performed the initial test consisting of two questions. Based on the data obtained from the mathematical communication test it was found that most students responded with a less clear idea. In relation to the identification of the problems above, it can be concluded that the problems in class XI IIS 1 SMAN 1 Blahbatuh is the low ability of mathematical communication owned by students in learning activities. This will affect the low ability of students in communicating correctly on the problems given, so the results of tests given by teachers tend not to meet the criteria. Therefore, the students' mathematical communication needs to get appropriate attention and solution.

The importance of mathematical communication in the mathematics fields, the educators should certainly help the students to achieve optimal results in mastering communication skills. Various efforts can be done, one of them by providing an appropriate learning model for students. According to Balim (2009), the learning model that appropriate to a constructivism approach which can make students more effective in building their own knowledge needs to be used. One of the learning models based on constructivism is the reasoning and problem-solving learning model (MP3M). Reasoning and Problem Solving Learning Model is one of the learning models that can generate students' reasoning skill so that their creativity develops that ultimately students are trained to think logically, critically, and creatively (Suryawan, 2012).

Reasoning and problem solving learning model is done through group learning system so that communication between student and student, student and teacher can happen. The dominance of teachers in learning activities can be reduced and students try to learn by finding the concept/subject matter independently. MP3M consists of five stages: (1) Reading

and thinking, (2) Exploration and planning, (3) Selection of strategy, (4) Finding the answers, (5) Reflection and expansion. MP3M is very relevant to apply in the effort to grow the aspects of indicators of mathematical communication. Reading and thinking can motivate students to organize and consolidate mathematical thinking and communicate it. Exploration and planning can motivate students to communicate mathematical thinking coherently and clearly. Selection of strategies can motivate students to analyze and evaluate mathematical thinking and strategies. Finding the answers can motivate students to evaluate mathematical ideas and use mathematical language to express mathematical ideas appropriately. Reflection and expansion can motivate students to present ideas and illustrate relationships with other situational models. The integration of the five sections in MP3M will optimize the indicators contained in the mathematical communication of students in learning mathematics. So it is believed to improve students' mathematical communication skills.

It is also supported by some relevant research results one of them: 1) The research result of Suryawan (2012) where the Development of Mathematics Learning Tool for Reasoning and Problem Solving Learning Model (MP3M) Oriented in Problem-Solving is able to Improve Learning Activity and Achievement of Student in Class VII. 2) The results of Suarsini et al. (2013) in which the Reasoning and Problem Solving learning model has been able to contribute positively in improving the students' mathematics learning outcomes.

The purpose of this research is to know (1) the improvement of mathematical communication ability of student of class XI IIS 1 SMAN 1 Blahbatuh through the implementation of MP3M and (2) the responses of students in class XI IIS 1 SMAN 1 Blahbatuh toward the implementation of MP3M.

Materials and Methods

The research is a collaborative classroom action research that generally aims to improve and fix the quality, process, and learning outcome of mathematics in the classroom. This research was conducted in 3 cycles. In this research, PTK that is used is Kurt Lewin model. According to Lewin (in McNiff, 2013) each cycle consists of 4 stages namely, action planning, action implementation, observation and evaluation as well as reflection and the learning actors in this research that is mathematics teacher of class XI IIS 1 SMAN 1

Blahbatuh. Each cycle is held during 4 meetings consisting of 3 meetings for the implementation of the action and 1 meeting to conduct the final test cycle. In addition, before the implementation of the action, simulations that related to the learning model that will be used are done. Data of mathematical communication skills and student responses were collected and then analyzed using descriptive analysis technique.

Subjects in the study were all students class XI IIS 1 SMAN 1 Blahbatuh in first semester 2017/2018 academic year as many as 32 students. Whereas, the object studied in this research is students' mathematical communication ability and responses to MP3M implementation. Instruments in this research are test, questionnaire, and journal. The test used to collect students' mathematical communication data takes the form of a description test. Meanwhile, questionnaires were used to collect data on student responses to the implementation of MP3M. In addition, journal is used to describe students' mathematical communication abilities.

The collected data then analyzed descriptively, that is by calculating students 'mathematical communication skill score from the Minimum Criteria of Mastery (KKM) on the subjects of Mathematics and students' learning completeness, as well as the average score of student responses. The criteria used in classification of students' mathematical communication skills are presented in Table 1.

Furthermore the students' responses data to MP3M is measured by using Likert scale. Questionnaires are arranged with a strongly agreed choice (SS), agree (S), less agree (KS), disagree (TS) and strongly disagree (STS). To see the seriousness of students in the questionnaire, the researchers used two models of questions or statements in the questionnaire, namely positive statements and negative revelation. The criteria for scoring students' responses are presented in Table 2.

Table 1. Minimum Criteria Mastery of Students' Mathematical Communication

No	Student's Mathematical Communication Score	Category
1.	$75 \leq \bar{X} \leq 100$	Complete
2.	$0 \leq \bar{X} < 75$	Not Complete

Based on the criteria for scoring student responses, the score of each student is obtained by summing all scores based on the student's choice on each item of the question. To know the student's responses to the applied learning, will be analyzed by determining the average score of students' responses.

Furthermore the student response data is analyzed descriptively based on the mean score $(\overline{T})$, ideal mean (M_i), and standard deviation (SD_i) are determined by criteria in Table 3 below.

Thus can be determined students' responses to the learning applied as a success indicator that is when the students' responses are at least in the positive criteria.

Results and Discussion

Data of students' mathematical communication skills in the initial reflection phase, cycle I, cycle II, and cycle III are presented in Table 4. Based on Table 4, it is generally seen that the mathematical communication of the students of class XI IIS 1 in SMAN 1 Blahbatuh has increased. The average increase of students 'mathematical communication value from initial reflection to cycle I is 0.6 from the average of mathematical communication score that students have on the initial reflection,

Table 2. The Criteria For Scoring Students' Responses (modified after Candiasa, 2010)

Answers Analysis	Score	
	Positive	Negative
SS	5	1
S	4	2
KS	3	3
TS	2	4
STS	1	5

Table 3. Criteria of Students' Responses Category (modified after Candiasa, 2011)

No	Score Range	Criteria
1.	$\overline{T} \geq M_i + 1{,}8SD_i$	Very Positive
2.	$M_i + 0{,}6SD_i \leq \overline{T} < M_i + 1{,}8SD_i$	Positive
3.	$M_i - 0{,}6SD_i \leq \overline{T} < M_i + 0{,}6SD_i$	Moderate
4.	$M_i - 1{,}8SD_i \leq \overline{T} < M_i - 0{,}6SD_i$	Less
5.	$\overline{T} < M_i - 1{,}8SD_i$	Very Less

the increase of the students' mathematical communication value from the initial reflection to cycle II is 25, 3 of the average students' mathematical communication scores on initial reflection, and the increase in mathematical communication that students have from the initial reflection to the third cycle of 32 from the average mathematical communication score on initial reflection. Increasing the mean value of students' mathematical communication at the initial reflection stage, cycle I, cycle II, and cycle III can be presented in Figure 1.

Improved learning completeness students of class XI IIS 1 in SMAN 1 Blahbatuh classically in the initial reflection phase, cycle I, cycle II, and cycle III can be presented in Figure 2.

Table 4. Data of Students' Mathematical Communication Skills

No	Category	Initial Reflection		Cycle I		Cycle II		Cycle III	
		F	P	F	P	F	P	F	P
1.	Not Complete	31	96,9%	29	90,6%	12	37,5%	6	18,8%
2.	Complete	1	3,1%	3	9,4%	20	62,5%	26	81,2%
Average Score		50,8		51,4		76,1		82,8	
Learning Mastery		3,1%		9,4%		62,5%		81,3%	

F = Frequency; P = Percentage

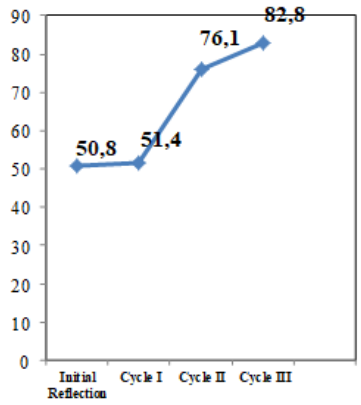

Figure 1. Graph Distribution of Students Average Mean Score on Mathematical Communication at Each Cycle

At the end of the third cycle meeting, students were also given a questionnaire to find out the students' responses to the application of MP3M. The average score of student responses to MP3M implementation during the learning process is as follows.

The percentage of student responses to the MP3M application for each category is presented in Table 5. Data distribution of student responses to MP3M implementation is presented in Fig. 3.

Based on the average score of students' responses to the implementation of MP3M during the learning process, it can be concluded that the learning through the implementation of MP3M get positive responses from the students according to the criteria of the classification of student responses, so that students' responses to the implementation of MP3M during the learning process has met the criteria of success indicators.

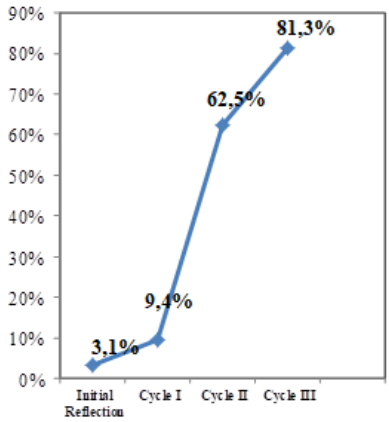

Figure 2. Graphic Improvement of Students' Learning Completeness

Table 5. The Percentage of Students' Responses to the MP3M Application

	Very Less	Less	Moderate	Positive	Very Positive
No. of Students	0	0	0	29	3
Percentage	0 %	0 %	0 %	90,6 %	9,4 %

The achievement of student's mathematical communication optimally occurs in cycle III, it can be seen from the improvement of action result which done to solve the problems encountered in observation and after the implementation of action in cycle I until cycle III have seen change and improvement of cycle to cycle. As for things that cause the increase in mathematical communication owned by students is as follows.

First, the teacher's learning process emphasizes more on the expression of mathematical ideas that leads the students by giving lecture questions in constructing students' mathematical ideas to construct their own knowledge in expressing their ideas and identifying problems. For example in translational material, it is given a matter of determining the image of a line translated by a translation matrix. Teacher provokes students by "Students, when the line is translated form will it change or not? Approximately, is the shadow of the line will be a line or a point? ". Through this action, it can reduce the students who are still difficult in doing the LKS, students are still difficult to understand, construct, identify, and solve problems that are in LKS. In this study this action has been done on cycle II and cycle III. At this stage students consider in solving a problem the importance of identifying the problem first. This causes students to have the ability to express strong mathematical ideas because students can construct their own knowledge.

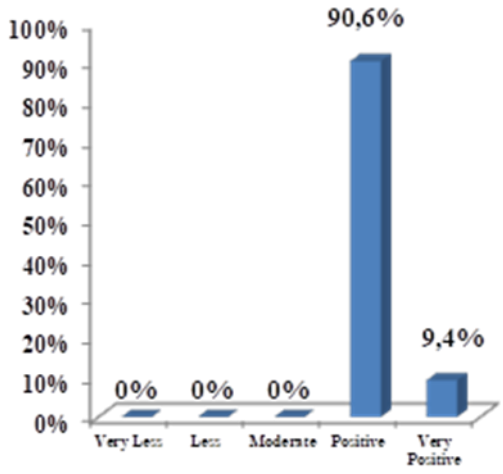

Figure 3. Data Distribution of Student Responses

Second, give students more opportunities to express their opinions. In addition, mathematical communication of students will be good if continuously given the problems by the teacher through the provision of independent tasks. By working on various problems, students are accustomed to using and developing mathematical communication in solving the problem. This will indirectly strengthen the mathematical communication of a material. This is in line with the opinion expressed by Crawford (2001) which states that the learning method implemented focuses on the meaningful aspects of learning activities, meaning that teachers should emphasize the giving of tasks in the classroom as something relevant and authentic that has meaning in the real world.

Third, teachers provide guidance and motivation to students, providing opportunities and emphasis to students to actively respond, convey the results of discussion, answer or provide refutation to express mathematical ideas by the students. So that teacher can know the ideas that students have either logical ideas or not in the process of working out the LKS. Teachers mediate the ideas of students who are not logical, so that students are not wrong when choosing the wrong strategy in working on problems that exist in the LKS. To avoid the constraints which found in cycles I and II related to the seriousness of students in following learning which is less and the presence of several groups dominated by one to two students then the student appointment is done randomly. This action is very efficient to do because if seen from the implementation of the cycle I to the implementation of cycle III there are changes and developments in the ability to respond to convey mathematical ideas, answer or provide questions about the mathematical ideas that learned. This is in line with what the Ministry of National Education (2016) states that students will learn mathematics if they have motivation, which in the learning process can be implemented individually or in groups.

Fourth in the learning process students are given several videos related to the material taught at the beginning of learning to facilitate students find mathematical ideas and motivation to follow the learning. The activities are carried out on some materials that require illustrations, so that students can understand the material easily. This is in accordance with the statement proposed by Komalasari (2010), the learning process will take place quickly if students are given the opportunity to utilize the source of learning, and conduct forms of

research activities actively. To encourage attraction and motivation, it is useful to use learning and media models such as audio, video, reading and reviewing textbooks.

Through the improvements made by teachers in the learning process from cycle I, cycle II and cycle III make students able to express their mathematical ideas such as giving intensive guidance, motivation and reinforcement to students so students more eager in learning the material which has been given. So in the third cycle there is no longer a significant problem. This is because the learning process in cycle III is getting better and in accordance with the planned expectations compared with previous cycles. The implementation of MP3M in learning mathematics in class XI IIS 1 of SMAN 1 Blahbatuh running smoothly, it is in accordance with the theory because the constraints which faced can be resolved through reflection of each learning process and each cycle so that mathematical communication owned by students in learning that has been done has increased from cycle to cycle.

This is in line with research conducted by Suryawan (2012) entitled "Development of Mathematical Learning Tools for Reasoning and Problem Solving Learning Model (MP3M) Oriented in Problem-Solving is able to Improve Learning Activity and Achievement of Student in Class VII" . From the research, it was found that the learning tools of mathematics for MP3M oriented in problem-solving for the students of SMP class VII on the standard competency in understanding the concept of triangle and quadrilateral as well as determine the size that has met the criteria of validity, practicality, and expected effectiveness and able to increase the activity and achievement of learning mathematics students. The support of this research is to apply student-centered learning model as well as during the learning process, the characteristics that appear are recorded in the observation sheet. In addition to the increase in mathematical communication owned by students, the application of MP3M in learning mathematics also get positive responses from students. Thus, the results of this study have met all the predefined success indicators.

Conclusion

In general, the improvement of mathematical communication owned by students of class XI IIS 1 SMAN 1 Blahbatuh from cycle I to cycle II amounted to 24.7 with an average of 51.4 in cycle I to 76.1 in cycle II. Then from cycle II to cycle III has increased 6.7 to 82.8 with percentage of number of complete student equal to 81,3% in cycle III and have fulfilled indicator of success that is minimum fulfill value of 75 and have improvement from cycle to cycle and number of student which is complete are over 70%. This improvement occurs due to various actions that have been done by the teacher are: 1) Directing students through the questions of inducement to make it easier for students to understand the problem given. In addition, teachers also provide an overview of problems in the form of stories or phenomena that are interesting and familiar to students, 2) Always give re-emphasis to students to not fear or embarrassed in expressing opinions, answering questions from teachers or students besides that, it emphasizes that activeness in the learning process also becomes one of the assessed aspects and gives positive reinforcement to the student who asking the question. 3) Provide motivation to students to be active during the discussion and always concentrate in learning. In addition, teachers are also informed to the active students will be given additional points, so students will be motivated to be active in the discussion, 4) Reprimand the students who are not disciplined in the group and ask to focus more on group discussions. Ask students to be more active in the delivery of ideas in their group and to motivate students to be more confident in expressing ideas.

Students' responses to the MP3M implementation was collected through questionnaires that is no students responding to learning that was very less, less and moderate. Based on the percentage of the number of students who gave positive responses was 90.6% (29 students) and the percentage that gave a very positive response was 9.3% (3 students). Overall student responses to the implementation of MP3M is quite positive, that is the average score of responses of students is 57.2 this is in accordance with indicators of success in this study

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