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Mathematics Communication Based on Students' Self – Efficacy in Problem Based Learning Assisted By Mobile Learning

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Abstract

This research aims to describe mathematics communication skill based on self-efficacy of students in problem based learning assisted by mobile learning. This research was a concurrent embedded. The population was X grade students of MAN 1 Kota Pekalongan. The technique of sampling was purposive sampling. It was selected X MIA 2 as experimental group. The subjects were grouped based on self-efficacy with high, moderate, and low categories to be interviewed about their mathematics communication skill. The instruments were test and interview. The findings showed that PBL assisted by mobile leanring was qualified. The result of mathematics communication description based on self-efficacy was varied, it was shown from 8 students with high self-efficacy, there were 5 students categorized high, 2 categorized moderate, and 1 categorized low. From 20 students with moderate self-efficacy, there were 5 students categorized high, 11 categorized moderate, and 4 categorized low. From 8 students with low self-efficacy, there was only 1 students categorized high, 2 categorized moderate, and 5 categorized low.

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INTRODUCTION

Mathematics is a universal science which becomes the basic of modern technology development. It has important roles in various disciplines and develops human thoughts (Permendiknas, 2006). Susilo & Kharisudin (2010) state that mathematics is a deductive – actiomatic and abstract science. The important role of mathematics in life causes its importance to be given at schools, especially primary and moderate education levels.

According to Permendiknas RI No. 22 Year 2006, one of mathematics purposes at school is to make students having mathematics communication ability. This ability has important role and shold be improved at school (Qohar, 2013; Asikin & Iwan, 2013). It should be developed within the students (Munawar, 2013). According to *National Council of Teahcer of Mathematics* (NTCM, 2000), the mathematics communication skill is an ability to share mathematics ideas through writing, spoken language, figure, graphs, and other visual realizations. Mathematics communication is ability to communicate by involving skills to manage idea, symbol, term, and any observed information through listening, presenting, and discussing (Ramdani, 2012). Communication is an essence from teaching, assessing, and learning mathematics (Umar, 2012). The influential factors of mathematics communication, one of them, is student *self – efficacy* (Nurdiana, 2018).

Mathematics communication consisted of two aspects: written and spoken communication (Hodiyanto, 2017). Spoken communication could take form as students' arguments in solving a problem. Written communication may take form into students' works in finishing a problem.

To be able in communicating solutions of problems, the students sometimes felt unsure in communicating their works. They were afraid if they made mistake and doubt if their answers were correct or not. There were also students who knew the final result of the problem but they did not write the steps of the solution. It made them having low mathematics score. It was described as *self-efficacy* causing to low mathematics students' communications.

Self-efficacy is a belief of students upon their own abilities in finishing the task so they could achieve the expected objectives (Ahmad, 2016). Hardiyanto & Santoso (2018) stated one of affective aspect influencing learning success is *self-efficacy*. Amri & Widada (2019) state that *self-efficacy* influencing positively to mathematics understanding.

Learning mathematics will be more meaningful when a discussion process and sharing argument take place. Through discussion, students will be trained to communicate. The leanring model expected to facilitate students in improving their mathematics communication skill and developing their *self-efficacy* is *Problem Based Learning* (PBL).

Problem Based Learning (PBL) is a learning model oriented to problem presentation, organization, discussion, guidance, investigation, presentation, and evaluation (Rusmono, 2012). Setyaningsih et al (2014), Purnomo et al (2015), Atiningsih (2018), & Zufah et al (2018) state that problem based learning model is an approach correlating problems as initial step. Then, it is proceded to find concept and solve the problems by helping each other to get new knowledge.

PBL could motivate students and facilitate problem solving (Dwiyanto et al, 2017). It creates them to be more active in solving problem (Peranginangin et al, 2019). Perwitasari & Surya (2017), Rafli et al (2018) state that PBL significantly influence mathematics communication skill of students.

To create interactive learning, teacher needs to innovate to current technology development. In learning mathematics, it is often experienced boredom during expository class. Setyaningrum & Waryanto (2017) state that through game android media, students would be more interested in learning. The learning process could be interactively promoted and fun.

Taufiq et al (2016) states that application assisted by android has superiority from its features, such as pictures, videos, and supportive learning questions. The presented materials through android would be more interesting and interactive because it is not only written. Such application can facilitate students understanding broader and abstract concept. Wardani et al (2017) state that by using application assisted by android, learning will be more interactive

and fun. The students would be facilitated to understand mathematics concept.

The problem formulation in this research consists of (1) how *Problem Based Learning* quality assisted by *model learning* to mathematics communication skill is; (2) how mathematics communication of the students based on *self-efficacy* during *problem based learning* assisted by *mobile learning* is. Aligning with the problems, the purposes of the research are to describe the quality of *Problem Based Learning* assisted by *mobile learning* toward mathematics communication skill, to analyze mathematics communication skill seen from *self-efficacy* during *PBL* assisted by *mobile learning.* Learning quality in this research was measured by three stages: planning, implementation, and assessing.

METHOD

This mixed method used concurrent embedded design. It is an approach to combine qualitative and quantitative methods. (Creswell, 2014). This research was begun by preliminary study. Then, it was continued by data collection, analysis, and interpretation.

The research was done at MAN 1 Kota Pekalongan with population taken from X grade in academic year 2018/2019. The subjects consisted of 36 students taught by PBL assisted by mobile learning. There were also 34 students taught only by PBL.

The data source was taken from mathematics communication skill test (TKKM), self-efficacy questionnaire, mathematics communication skill interview sheet, and teacher activity observational sheet. The TKKM result functioned as quantitative data source. The qualitative data was taken from TKKM sheet, the questionnaire, and interview. The quantitative data was tested its normality, homogeneity, proportion, average passing grade, comparative propotion, and comparative average. The qualitative data was analyzed in term of validation. The other qualitative procedure was transcribing verbal data, reducing data, presenting data, and verifying data.

RESULT AND DISCUSSION

During planning stage process, the average score of learning instrument validation was 4.68. The average score of learning medium validation was 4.8. The average of learning instrument validation was 4.78. Here are the explanation of each learning and research instrument validation. It could be seen on table 1.

Table 1 Result of Learning Instrument, Learning Media, and Research Instrument Validations

Instrument/Media/Research Instrument	Average	Categories
Syllabus	4.66	Very well
Lesson Plan	4.75	Very well
Worksheet	4.64	Very well
Trigonometry Mobile *Application*	4,8	Very well
Questionnaire of the students' *Self-efficacy*	4.83	Very well
TKKM questions	4.85	Very well
KKM interview guideline	4.71	Very well
Learning Promotion Observation Sheet	4.8	Very well
Questionnaire of the students' responses	4.7	Very well

From the result, it is said that instruments, media, and research instrument were categorized well and could be used in the research.

During learning process, the learning quality was measured by learning activity observation and the student questionnaire. From the observation, it was gained the average skill score in managing learning was 4.62 or 92.6%. Thus, the learning promotion was categorized well. Based on the analysis of the student response, it was gained average 2.92 or 73% so that it could be said that the learning was held well.

During learning procee, the teacher facilitated students by worksheet and mobile application to train their mathematics communication. The worksheet was arranged by integrating the indicators of mathematics communication into each part of the worksheet. The given problem in the mobile application was adjusted to problems in the

worksheet. The communication result of the students was gained from discussion with their peers. It is in line with Widyaningrum (2015). She stated that moderate and high students' confidence could share their opinions properly. The mathematics symbol writing was already good. Rizki (2016) stated that students with high confidence could use accurate terms and notations.

In each learning achievement score, it was gined normal and homogeneous distribution scores of TKKM. During completeness test calculation and comparative test, the significant level or the used α was 0.05. The proportion of the completeness was 77.78%, with zcount was 0.4167 and $z_{\frac{1}{2}(1-\alpha)}$ was 1.96. Therefore, $-z_{\frac{1}{2}(1-\alpha)} < z_{count} < z_{\frac{1}{2}(1-\alpha)}$, it means tat the proportion of completeness was 75%. It was gained control group completeness proportion, 52.9%. Based on comparative proportion tets, zcount was 0.4167 and z(0,5-α) was 1.96. Thus, zcount ≥ z(0,5-α). It meant the proportion of the students' completeness or passing grade taught by PBL assisted by mobile learning was better than the students taught by only PBL.

The average score was 78.56 with tcount = 5.445 and t(1-α),dk = 1.689. Therefore, tcount > t(1-α),dk, it meant the mathematics communication skill of the students taught by PBL assisted by mobile learning was higher than 71. The average score of the control group gained 72.88. Based on comparative test analysis, tcount was 2.956 and t(1-α),dk was 1.669. Therefore, tcount > t(1-α),dk, it meant that average score of the students' mathematics communication skill taught by PBL assisted by mobile learning was higher.

There were 36 subjects of X MIA 2 of MAN 1, Pekalongan, categorized into high, moderate, and low self-efficacy students. Based on the questionnaire, it showed from 36 students, 8 of them categorized high, 20 – moderate, and 8 – low. The description of the students' mathematics communication skill based on self-efficacy levels were varied. It could be seen on table 2.

Table 2 Summary of Mathematics Communication Analysis Seen from the Students' *Self-Efficcy*

No	*Self-Efficacy*	Mathematics Communication Skill	
		Students' Numbers	Categories
1	High	5	High
		2	Moderate
		1	Low
2	Moderate	5	High
		11	Moderate
		4	Low
3	Low	1	High
		2	Moderate
		5	Low

Based on the table, it was gained 8 high self-efficacy students consisted 5 high mathematics communication skill students, 2 moderate level students, and one low communication level student. In high skill level, four indicators of mathematics skill were mastered by 5 students. In moderate category, only three indicators were mastered. There was also one indicator which had not been maximally mastered, solving a problem. In low category, there were two indicators were mastered and the other two indicators were not maximally mastered, drawing mathematics idea and solving a problem.

From 20 moderate self-efficacy students, 5 of them had high mathematics communication skill, 11 moderate level, and 4 low level students. The high mathematics category level students could master four indicators. The moderate category students only mastered two indicators well; one indicator was mastered well and only one indicator was not maximally mastered, solving a problem. The low category students, one indicator was mastered well but three indicators were not maximally mastered, solving a problem, drawing mathematics idea, and translating problems into mathematics symbols.

The low self-efficacy level students consisted of one high mathematics communication skill student, 2 moderate skill, and 5 low level skill students. The high communication students could master the indicators well. The moderate level communication students, two indicators were mastered well and only two indicators were not maximally mastered, solving

a problem and drawing mathematics idea. The low mathematics category student could only master one indicator. The other three indicators were achieved but not maximally mastered, drawing mathematics idea, translating problems into mathematics symbols, and solving a problem.

Based on TKKM and interview toward the subjects, it could be concluded that high self-efficacy students did not always have high mathematics communication skill. The moderate self-efficacy students did not always have moderate mathematics communication skill. The low self-efficacy students did not always have low mathematics communication skill. Zimmerman (2000) stated that self-efficacy assessment could direct to the students' interpretation and roles in motivating students academically.

The mathematics communication skill of high self-efficacy students was shown by active attitudes of the students during learning and sharing arguments. Thus, all indicators were mastered well. Mathematics communication skill of moderate self-efficacy students was shown by enthusiasm in learning although sometimes they were nervous in completing all indicators. Thus, the indicators were not maximally mastered. The mathematics communication skill of the students with low self-efficacy was shown by their passiveness, low enthusiasm, and easily giving up while facing problems. It made them not fully master all indicators. However, there were also students with low self-efficacy could master all mathematics communication skill indicators well. It showed mathematics communication skills of the students were not influenced by their self-efficacy.

CONCLUSION

Based on the analysis and discussion, it was concluded that the description of mathematics communication skill based on self-efficacy was varied, it means self-efficacy of the students did not influence mathematics communication skill of the students. Then, there was a need of PBL assisted by mobile learning to achieve mathematics communication skill of the students.

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