Comparison of Mathematic Communication Ability Through Problem Based Learning And Guided Discovery

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ABstrak. This study aims to examine differences in improvement in mathematical communication skills between students who obtain problem-based learning models and students who obtain guided discovery models, examine differences in mathematical communication skills improvement in terms of KAM level (initial mathematical ability), examine interactions between the two learning models and levels KAM students in improving mathematical communication skills of students who learn through problem-based learning models and guided discovery models. This research is a quasi-experimental study with a population of all eighth grade students in one of the state junior high schools in Tasikmalaya. The sample of this research is class VIII E and VIII G as many as 72 students. To obtain data in this study used an instrument in the form of a mathematical communication ability test. Data analysis was performed quantitatively using the t-test and the two-way Anova test. The results showed that: (1) there was no difference in the increase in mathematical communication skills between students who obtained problem-based learning models and students who obtained guided discovery models; (2) improvement of students' mathematical communication skills in the two lessons are both in the medium classification category; (3) there is no difference in the improvement of mathematical communication skills between students who take learning with problem based learning models and students who take learning with guided discovery models in terms of KAM; (4) there is no interaction effect between the two learning models and KAM level of students in improving students' mathematical communication skills.

1. Introduction

Communication is one of the competencies that must be developed in mathematics learning. The importance of communication is expressed by [1] that communication skills play an important role in learning mathematics as well as social activities in society. Mathematical communication as an activity that can help students in expressing mathematical ideas in their own language and can be understood by others. Communication activities are an essential part of human life. Communication means trying to understand and provide feedback for the speaker's message [2]. In the communication process, there are elements of communication and communicators known. Mathematics is increasingly seen as an area where effective communication is very important both as a learning process and results [3], in line with this opinion, communication is also an important part of mathematics and mathematics education. [4] communication in mathematics is recognized as an important aspect of mathematics learning, and that
includes sharing and explaining ideas, verbally and in writing. Learning that can support these activities is a problem based learning model (PBM), and a learning discovery learning model (PT).

PBM model is a learning model where students are faced with authentic problems so that students can organize their own knowledge, develop higher skills, independent students and increase self-confidence. [5] states that PBM is more effective for teaching mathematics. With problem-based learning it has an effect on content knowledge that provides greater opportunities for students to learn content with more involvement and increase student activity participation. According to [6] PBM is a constructivist learning approach that is centered on students based on the analysis, resolution and discussion of the problem given. Problem-based learning can be applied to other subjects, even problem-based learning is also very useful for teaching mathematics. [7] said that PBM is a student-centered learning approach that empowers students to lead investigations, integrate theory and practice, apply knowledge and skills to develop an appropriate solution to a problem. The success of this approach depends on the selection of problems that are ill-structured and the tutor who serves as a guide to the learning process and leads the question and answer to the conclusions obtained in learning.

PBM is a learning method that facilitates students in getting to solve problems that are at the core of learning [8]. Problems raised in PBM are complex. Students work in collaborative groups to identify what they need to solve problems, involve students in learning independence, apply the knowledge they have to the problem, reflect on what they are learning and how effective the strategies are used. Students who participate in the PBM environment have greater opportunities to learn mathematical processes related to communication, representation, modeling, and reasoning [9].

The guided discovery learning model facilitates students to learn independently through activities designed by the teacher. Students construct councilors, hypotheses, verify and generalize to build new knowledge. Supported by research conducted by [10] where research has shown the potential of guided discovery learning in improving student performance. The findings from this study also show that gender does not have a role to play in student performance with discovery learning can also stimulate low, medium and high students' ability to work better separately.

Based on these descriptions, this study aims to examine differences in improvement in mathematical communication skills between students who obtain problem-based learning models and students who obtain guided discovery models, examine differences in mathematical communication skills improvement in terms of KAM level (high, medium, low), and assess the interaction between the problem based learning model and the guided discovery model with the KAM level of students in improving students' mathematical communication skills.

2. Method
This research was conducted in seventh grade students totaling 72 students, from two classes that have the same abilities with different learning models. The two classes are given an initial test (pretest) that is a test of mathematical communication skills before being given treatment, after the treatment is carried out on the two groups, then given a final test (posttest) namely posttest mathematical communication skills. The subject of this study was not chosen randomly, so the study sample was determined by purposive sampling technique. Based on the consideration, two classes were selected as the research sample, namely class VIII E, which carried out the PBM model and class VIII G, which carried out the learning model of PT. The research design used in this study was a quasi-experimental design.

3. Result and Discussion
Based on the results of the study it was found that the average results of the two average similarity tests are explained in the following table.
Table 1. Data Results of the Equation Test of Two Average Normalized Gains Mathematical Communication Skills

| t-test for Equality of Means | T | Df | Sig (2-tailed) |
|-----------------------------|---|----|---------------|
| Ngain Equal variances assumed | -1.958 | 70 | 0.054 |

It was concluded that there was no significant difference in the average increase in mathematical communication skills between students who received PBM and students who learned PT. In addition, the improvement of students' mathematical communication skills both in PBM and PT is in the medium category. Based on the results of the analysis above, both learning have characteristics that are strong enough so that it can provide an increase in students' mathematical communication skills. This is in line with the opinion [11] PBM model can be effective to increase student confidence because they utilize the effects of curiosity, challenges, assignments and all the factors that increase student confidence for learning. Supported opinion [12] that PBM can help students investigate and analyze problems to develop their abilities in communication and collaboration, as well as the ability to access information and utilize that information.

The initial mathematical abilities in this study are used to categorize or group students into three groups namely high, medium and low. Based on statistical calculations, it was obtained a recapitulation of the average difference test in the N-Gain score of students' mathematical communication skills.

Table 2. N-Gain Average Difference Test Data Mathematical Communication Skills in High, Medium and Low Groups

| t-test for Equality of Means | df | Sig (2-tailed) | Ket. | Conclusion |
|-----------------------------|----|---------------|-----|------------|
| N-Gain High Group Equal variances assumed | 9 | 0.533 | $H_0$ Accepted | There is no difference |
| N-Gain Medium group Equal variances assumed | 46 | 0.163 | $H_0$ Accepted | There is no difference |
| N-gain Low group Equal variances assumed | 11 | 0.094 | $H_0$ Accepted | There is no difference |

It was concluded that there was no significant difference in the average increase in communication skills between students who took PBM and students who took PT learning in terms of high, medium and low student Mathematical Ability (KAM). PBM and PT learning can improve mathematical communication skills in all KAM categories of students. The following is a summary of the results of the two-way ANOVA.

Table 3. Test Results of KAM Interaction and Learning On Improving Mathematical Communication Capabilities

| Factor | F | Sig. |
|--------|---|------|
| KAM * Learning category | 0.344 | 0.710 |

Based on table 3, the significant value of the KAM factor * Class is 0.710, more than 0.05 $H_0$ conclusions are accepted, meaning that there is no interaction between the two learning models and the level of KAM students in improving students' mathematical communication skills. This shows that there is no interaction between the learning approaches to capacity building. This finding shows that the
effect of learning factors on improving mathematical communication skills does not depend on the KAM factor. The following is presented picture 1 interaction between learning and KAM.

![Estimated Marginal Means of ngain](image)

**Figure 1.** Interaction between classroom learning and KAM

Figure 1 explains the results of the two-way ANOVA test which shows that there is no interaction means that the shared factors between learning and KAM do not significantly influence the improvement or development of students' communication skills. The lack of interaction shows that differences in learning and KAM do not result in differences in the improvement of students' mathematical communication skills after learning. The difference in increasing students' mathematical communication skills is only caused by differences in learning used, but learning is not influenced by KAM. The finding of no interaction shows that learning with PBM and PT is relatively appropriate to improve students' mathematical communication skills in all KAM categories.

However, when seen from Figure 1 shows that the application of PT learning shows an average increase in both the PBM. In class with PT learning students with low KAM have an average N-Gain almost equal to students with moderate KAM, from this discovery there is a chance that students who have low initial ability can have the same average with the mathematical initial ability of students who are currently even higher if further PT learning is done. In other words, PT learning can be learning that provides positive benefits for students with low mathematical initial abilities.

In the course of PBM implementation, the teacher's role in managing fluency during the learning process is very important, in accordance with the opinion [13] stating that in solving problems often involves the application of various mathematical procedures, so the teacher must focus on ways to proactively present the subject matter so that it can guide efforts student learning, while students strive to be active, self-monitoring constructors of knowledge. In this study, students are asked to be active in the learning process. Whereas the teacher only acts as a facilitator.

Although at the time of the implementation of problem-based learning sometimes students can not solve all the problems contained in student worksheets (LKS), but with this learning can help develop student thinking strategies, this is consistent with research conducted by [14] from his research showing that PBM sessions increase their self-expression, so their thought processes have been developed in the PBM application process. In the process of discovery, students are assisted by student activity sheets (LAS). Giving LAS to PT learning, provides greater opportunities for students to explore and discover new discoveries that have not been known before or find knowledge that is similar to previously known
with the help of teacher guidance that directs students. In line with what was stated by [15], namely in conducting discovery activities, students interact with other students. Interaction in the form of sharing or students with weak abilities ask clever students and students who are good at explaining it. Interactions also occur between the teacher and certain students, with several students or simultaneously with all students in the class. [16] also argues that the use of PT learning models is one variation of learning models that makes active students with the teacher as their guide believed to be able to increase student success.

4. Conclusion

Based on data analysis and discussion of the results of the research described in the previous chapter, it was concluded that there was no difference in the improvement of mathematical communication skills between students who received PBM and students who obtained PT learning, the improvement in students' mathematical communication skills in both learnings was in the medium category. Improvement of students' mathematical communication skills in both learning are in the medium classification category. There is no difference in increasing mathematical communication skills between students who take PBM and students who take PT learning for high, medium and low groups. And there is no interaction effect between the two learning models and KAM level of students in improving students' mathematical communication skills. In other words, it shows that the influence of learning factors on improving mathematical communication skills does not depend on KAM. Where the discovery of an average increase in communication skills of students with low KAM in PT learning models is almost the same as the average increase in communication skills of students with moderate KAM on PBM models.

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