Implementation of peer tutor learning in improving students' mathematical understanding ability

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Abstract. The purpose of this study was to apply peer tutoring learning to improve students' mathematical understanding skills. The method used in the study was a quasi-experimental method with a pre-test post-test control group design. The place of research was conducted in one of the universities in Banten. Samples were taken by two classes purposively. The research sample chosen consisted of two classes, namely 39 students in the experimental class and 38 students in the control class. The research instrument used was a test of comprehension ability. Data analysis is used in processing N-Gain results. The results of the study show that: 1) the achievement of the ability of mathematical understanding of students who study with peer tutoring learning is better than students who study conventionally; 2) improvement in students' mathematical understanding ability in experimental class (peer tutoring) better than control class (conventional).

1. Introduction

Exhaustiveness and student learning outcomes in the mathematics learning process appear to have significant problems such as other subjects, even though the learning process in learning is still centered on teacher-centered (conventional approach) namely lecturers as individuals who play a more active role (material giver) while students act as passive recipients of knowledge in the mathematics learning process. Ever tried the process of learning mathematics with the method of discussion, but students are still passive in expressing opinions and who always express their opinions actively are still done by the same students [1]. This is if left unchecked, there will be misunderstandings and dissemination of understanding the material delivered is not evenly distributed. Previous research suggests that misunderstandings still occur in students learning mathematics [2–4].

The difference in student academic abilities from one another is one form of heterogeneity in the classroom. The heterogeneity of students in the teaching and learning process is fast reflecting the heterogeneity of our society, and must thus be seen as an opportunity to 'maximize' the learning process. Diversity is a challenge and an opportunity to learn from differences in student abilities so as to require students to have a competitive ability to face dynamic industrial needs. This is a strong public demand for social skills and teamwork [5]. Social interaction skills and the ability to solve problems are challenges in learning mathematics to deal with industrial needs. This requires a learning model in compiling a peer interaction environment so as to equip students to develop social skills and understanding ability in mathematics learning [6].
Mathematics learning has a purpose in increasing the ability of understanding until reasoning is contained in the learning [7]. The mathematical learning approach that provides opportunities for all students to be able to improve the ability of students to understand mathematics mathematically to solve problems and have the ability to social interaction is a method of peer tutoring. Expert opinion reveals that peer tutoring is a cooperative learning strategy with potential benefits that can be very beneficial for students and previous research found that peer tutoring strategies were effective strategies for improving mathematics achievement and recommending lecturers to use peer teaching to improve student academic abilities [6, 8].

Peer tutors are someone or several students who help students who have difficulty with the reason that students are easier to accept information or explanations for their peers and describes the peer tutoring environment as a safe interactive learning situation [1, 9-10]. This is because the language used is more communicative, namely, its language and there is no shame to ask questions or ask for the information again to peers who are tutors. These facts indicate that the peer tutoring approach has the potential to be able to improve mathematical understanding skills and provide opportunities for students to be active in mathematics courses.

2. Method

The type of research used is quasi-experiment. The design used in the study was a pre-test post-test non-equivalent comparison group design. The group used in the study consisted of two groups (experiment and control). The first group was given the peer tutoring method (experiment) and the second group was given conventional treatment (control). The study was conducted at the State Islamic University of Sultan Maulana Hasanuddin Banten in the academic year 2018/2019. The research was conducted from February 25 to March 29, 2019.

The study population was all second-semester students in Islamic economics majoring in 2018/2019 which contained several classes. The study was selected by two classes non-randomly but the existing class as a sample. The selected class group is class B and C. The sample involved as many as 77 students, 39 students of the experimental class who were given learning using peer tutors and 38 control class students who were given conventional learning.

The research design in the study was a pre-test, post-test non-equivalent comparison group design. Students of both classes were given tests of mathematical comprehension ability both before being given treatment and after treatment. The type of research data used is quantitative data obtained based on the results of understanding tests in economic mathematics courses. Tests of mathematical comprehension ability in the form of a description test as many as five questions. Understanding ability test through stages of validity, reliability, level of difficulty, and differentiation so that it is suitable for use in research.

The stages of research data collection techniques are as follows: 1) preparation of research instruments and research teaching materials; 2) asking for instrument validation reviewed by lecturers who have competence in mathematical content, and language; 3) test the research instruments to test the validity, reliability, level of difficulty and distinguishing power; 4) provide an understanding ability test (research instrument) in the study sample before being given treatment; 5) giving treatment to the research sample; 6) provide an understanding ability test after treatment; 7) analyze data.

| Table 1. N-Gain Classification. |
|---------------------------------|
| Interval                        |
| High                            | g > 0,7                    |
| Medium                          | 0,3 < g ≤ 0,7              |
| Low                             | g ≤ 0,3                    |

Analysis of the data used is descriptive analysis, which is to describe the data from the results of the study. It describes the results of the mathematical understanding abilities in the form of averages, standard deviations, variances, maximum scores, and minimum scores. The research data were
analyzed before the treatment (pre-test) and after treatment (post-test) based on aspects of students' mathematical understanding abilities. Data obtained from mathematical comprehension tests in the form of a description of the questions as many questions with a maximum score of 100. Furthermore, the score was analyzed using the difference in average (t-test) and N-gain classification [11] (Table 1).

Data processing begins with testing the statistical requirements needed as a basis for testing hypotheses, namely the normality test and the variance homogeneity test for each group of data tested. After the data meets the normal and homogeneous requirements, then the difference test is carried out on average using the t-test which is the Independent Sample Test. If the data is normal and not homogeneous then testing the difference on average uses the t-test. However, if one group data is abnormally distributed, then testing the data using the Mann-Whitney U.

3. Result and Discussion

3.1. Analysis of Achievement of Students’ Mathematical Understanding Ability

After doing statistical tests, it is obtained in Table 2 to show descriptive statistics of the results before and after the tests for both groups. The pre-test results obtained scores of students in the control group and experimental groups 43.21 and 44.53 from 100 points, and those scores increased to 72.82 and 67.73 respectively after receiving treatment. The results of the pre-test score showed that the control group was higher than the experimental group (44.53, 43.21).

|                | Pre-Test | Post-Test |
|----------------|----------|-----------|
|                | N        | Mean      | SD | Sig  | Mean | SD | Sig |
| Experiment     | 39       | 43.21     | 6.55 | 0.277 | 72.82 | 11.35 | 0.030 |
| Control        | 38       | 44.53     | 5.78 |         | 67.73 | 11.40 |        |

The pre-test results were analyzed to compare the value of their initial mathematical abilities before treatment. The pre-test was conducted to ensure that the samples were used from the same two groups. The pre-test results show that there is a control group that is abnormally distributed, the statistical test is used to test the difference in the average sample is the non-parametric test, namely Mann-Whitney U = 634.500, Z = -1.087, and Sig = 0.277 (Table 3), the two groups are the same to see the achievement and improvement of students' mathematical understanding skills can be seen through the post-test score test.

|                | Mann-Whitney U | Z | Asymp. Sig. (2-tailed) |
|----------------|----------------|---|-----------------------|
| Pre-Test       | 634.500        | -1.087 | 0.277                |

The post-test results were analyzed to compare the value of students' mathematical understanding after treatment. The results show that the shows are not normally distributed in the control group, so the statistical test used to test the difference in the average sample is the non-parametric test namely Mann-Whitney U = 528.500, Z = -2.167, and Sig = 0.030 (Table 4) shows that students of peer tutors have mathematical understanding skills better than conventional groups.

|                | Mann-Whitney U | Z | Asymp. Sig. (2-tailed) |
|----------------|----------------|---|-----------------------|
| Post-Test      | 528.500        | -2.167 | 0.030                |
3.2. Improvement Analysis of Students’ Mathematical Understanding

The N-gain results in the control class are not normally distributed, so homogeneity tests are not carried out but directly using the Mann-Whitney U non-parametric test (Table 5).

**Table 5.** Average Difference Test of Understanding Ability N-Gain Score.

| N-Gain | Mann-Whitney U | Z       | Asymp. Sig. (2-tailed) |
|--------|---------------|---------|-----------------------|
|        | 488.000       | -2.579  | 0.010                 |

Table 5 show the probability value (sig.) = 0.010. This value is smaller than the 0.05 significance level set, so it can be concluded that the increase in students’ mathematical understanding skills with peer tutors (experimental group) is better than students who study with conventional learning (control group).

**Table 6.** Quality Improvement of N-Gain Understanding Capabilities.

| N-Gain | \( \bar{x} \) | SD   | Improved Quality |
|--------|---------------|------|------------------|
|        | 0.529         | 0.186| Medium           |
|        | 0.419         | 0.178| Medium           |

The ability of students' mathematical understanding includes the dimensions of comparing, identifying, making non-examples, changing forms, making examples and presenting shows an average total score of 72.82 for the experimental group and 67.73 control groups from 100 points (Table 2). Although the increase in the ability of the experimental class to improve is better than the dick class (Fig. 1). However, for the improvement category, the mathematical understanding ability of the experimental class and the control class is in the moderate category (Table 6). Based on the results of these studies recommend learning mathematics by using a little lecture, focusing on interaction (discussion) with peer tutoring methods so as to increase student competence. This is in line with previous research that mathematics learning uses focus discussion by developing peer tutoring methods [6,12–15].

![Average Understanding Ability](image_url)
When given problems regarding the application of functions in economics students were enthusiastic in learning mathematics using peer tutors. This is because the application of peer tutoring learning involves students actively in the process of learning mathematics-economics. In addition, students can work, overcome difficulties, discuss with peers who have an impact on achievement (Table 4) and increase the ability to understand peer tutors classes better than conventional (Table 5). The findings of previous studies also state that peer tutoring learning can improve students' understanding [1,16].

Based on the results of peer tutoring research, it is one of the research-based learning practices that have a positive impact on the results of academic competence, namely the improvement of students' mathematical understanding skills (Figure 1) and facts in the mathematics learning process. This finding is also in accordance with previous research on the impact of peer tutoring methods namely mathematical attitudes [17] dan good student social (academic) attitudes [15,18].

Based on the results of the study it is very promising in helping to improve the ability of understanding mathematics by using peer tutors in economic mathematics. Even so, the use of peer tutors must be careful because remembering it has a set of limitations. The findings of deficiencies in the use of peer tutoring methods are the first students assisted by colleagues (students who have the task as tutors) when the teaching and learning process has a less serious tendency so that the results of the discussion are not satisfactory, secondly there are some students who are somewhat shy about asking because Do not want to be seen as not able to students who have assignments as tutors, the three lecturers must really be able to determine the right tutor to guide. This is in line with what previous research revealed that: a) students who become tutors must pay attention in terms of their ability to master the material and the ability to help others; b) not all students can explain to their friends; c) not all students can answer their friends' questions [19]. Some of the presentation of the results of the study suggested that teacher / lecturer in using peer tutors should pay attention to preparing the initial mathematics proficiency test so that during the selection of true tutors who have the initial ability and have good mathematical communication, further research is suggested to use learning media as a supporting tool learning so that it can improve students' mathematical understanding skills even better.

4. Conclusion

Results of research in economic mathematics learning with peer tutors; 1) achievement of the ability of mathematical understanding of students studying with peer tutoring learning is better than students who study conventionally; 2) an increase in the ability of mathematical understanding students of the experimental class (peer tutoring) is better than the control class (conventional). Peer tutor learning strategies can be used as alternative learning to train student cooperation. Through the application of peer tutoring learning, lecturers must pay attention to the provision of learning tools, time allocation, divide student groups from the beginning in accordance with students' initial mathematical abilities, maintain communication with tutors to be able to detect improvement rooms, guide and direct student activities so learning objectives can improve student competence in learning mathematics.

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