Mathematical communication ability in Knisley mathematics learning model

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Abstract. The purpose of this research was to analyze the effectiveness of Knisley Mathematics Learning Model on students’ mathematical communication ability. Type of this research was quantitative research. The population in this research was grade VII students of one of junior high school in Semarang at 2018/2019 school year. With cluster random sampling technique, class VII H was obtained as an experimental class with Knisley Mathematics Learning Model and class VII G as a control class with Problem Based Learning models. Data collection includes tests of mathematical communication ability. Data were analyzed by classical completeness test, average difference test, and proportion test. The results showed that: (1) mathematical communication ability with Knisley Mathematics Learning Model had not yet reached classical completeness ie 59% while control class completeness was 36%, (2) the average achievement of students' mathematical communication ability in the Knisley Mathematics Learning Model class was higher than the average achievement students' mathematical communication in Problem Based Learning Model classes, and (3) the proportion of students' mathematical communication ability achievement in the Knisley Mathematics Learning Model class is higher than the proportion of students' mathematical communication ability achievement in Problem Based Learning Model classes.

1. Introduction
Mathematical communication ability must be possessed by students [1]. This is in accordance with Baroody and Ginsburg said that one of the fundamentals of mathematics education is to introduce mathematical communication abilities [1-2]. Cognitive and social activities are involved in developing mathematical communication abilities [2]. Communication is important in learning mathematics, both inside and outside the classroom [3-4]. Mathematical communication ability consist of oral and written [5]. Students' understanding of mathematics can be developed through mathematical communication ability both oral and written [6]. As examined in this study is mathematically written communication ability.

Mathematical communication ability can be seen from connecting real objects, images, and diagrams into mathematical ideas; explaining ideas, situations, and mathematical relations verbally or in writing, with real objects, images, graphics, and algebra; expressing daily events in the language of mathematics; listening, discussion, and writing about mathematics; reading written mathematical presentations and compiling relevant questions; and making conjectures, compiling arguments, formulating definitions, and generalizations [7]. Mathematics communication ability is very important for students so that they can solve mathematical ideas into a mathematics model,
and then connect the process into various mathematical concepts, into everyday life context, as well as into the other disciplines [8-9].

In addition, mathematical communication in writing helps students express their thoughts to complete strategies, increase knowledge in writing algorithms, and in general are able to improve cognitive abilities, so that indicators are used only (1) connecting real objects, images, and diagrams into ideas mathematics, (2) explaining ideas, situations, and mathematical relations verbally or in writing, with real objects, images, graphics, and algebra, and (3) expressing daily events in the language of mathematics [10].

The selection of appropriate learning models can affect the development of students' mathematical communication ability [11]. Knisley's mathematics learning model is a model of learning through experience in a mathematical context [12]. [12] explains that in the Kolb model, the student learning model is determined by two factors: students choose concrete to abstract and students choose the reflective active experiment. Knisley's mathematics learning model is the application of the Kolb learning cycle theory in four mathematics learning stage, namely allegorization, integration, analysis, and synthesis.

Based on the results of a preliminary study of mathematical communication ability in one of junior high school in Semarang towards 32 students with comparative material, the results showed that only 14 of 32 students or 43.75% of students were able to describe the problem in the form of graphics or images. In addition, based on the results of interviews with the one of junior high school in Semarang, mathematics teacher, the teacher revealed that there were some difficulties faced by students when working on the problem, the difficulties were students usually did not write important information that was known and asked in working on the problem so the teacher could not know students were able understand the questions given or not. In addition, students usually work on the problem without writing the formula first, so there is often inaccuracy when entering numbers into the equation. Based on the description above, The purpose of this research was to analyze the effectiveness of Knisley Mathematics Learning Model on students' mathematical communication ability.

2. Methods
The method used in this study is quantitative methods with true experiments designs. According to [13] there are two forms of true experimental design, namely posttest only control design and pretest group design. In this study using posttest only control design, in this design there are two groups, namely the experimental class and the control class. The population in this study were seventh grade students in one of junior high school in Semarang with Academic Year 2018/2019. Taking research sample in this study is based on random sampling. In this study, researchers took two samples, namely the experimental class and the control class. The experimental class group was students who were treated by the Knisley Mathematics Learning Model and the control group was students who were treated by the Problem Based Learning (PBL) learning model.

The technique used to collect data in this study is the test, giving the test is done to obtain data about mathematical communication ability in the circumference material and the rectangular flat building area of the students who were the samples in this study. The instruments used in this study were mathematical communication ability test instruments. Quantitative data analysis was carried out on data from the results of tests of mathematical communication ability including normality test, homogeneity test, classical completeness test, average difference test, and proportion test.

3. Results and discussion
Based on the normality test of the data from the test results of the mathematical communication ability of the experimental class using the Chi-Square Test with Microsoft Excel, it was found that the data were normally distributed. The normality test on the data from the test results of the mathematical communication class of the control class using the Chi-Square Test with the help of Microsoft Excel.
obtained data with normal distribution. Test the combined data normality of the two classes using the Chi-Square test, obtained data derived from populations that are normally distributed. Based on the classical completeness test used to find out the percentage of completeness of the experimental class students reached the set percentage, that is, at least 75% of the students in the class obtained a value of more than or equal to 74. The hypothesis was tested as follows

\[ H_0: \pi \leq 0.75 \] (the percentage of students in the experimental class who received a score of \( \geq 74 \) did not reach classical learning completeness)

\[ H_1: \pi > 0.75 \] (the percentage of students in the experimental class who received a score of \( \geq 74 \) reached classical learning completeness)

The test criteria is by testing the proportion of the left with a significant level of 5%, the criterion of rejecting \( H_0 \) if \( z > z_\alpha \). Based on the calculation results, calculations are obtained \( z = -2.157 \) and obtained \( z = 1.64 \). We get \( z < z_\alpha \), so \( H_0 \) accepted. Therefore, the percentage of students in the experimental class who received a score \( \geq 74 \) did not reach classical learning completeness namely 59% for Knisley Mathematics Learning Model class while the PBL class completeness is 36%.

Based on the hypothesis test the average difference used to determine the average mathematical communication ability of students with Knisley Mathematics Learning Model is higher than the average mathematical communication ability of students with the Problem-Based Learning model. The hypothesis is tested as follows.

\[ H_0: \mu_1 \leq \mu_2 \] (communication ability of the experimental class students were no better than the control class)

\[ H_1: \mu_1 > \mu_2 \] (communication ability of the experimental class students better than the control class)

if \( \sigma_1 = \sigma_2 \), then the test criteria is accepted \( H_0 \) if \( t > t_{(1-\alpha)(dk)} \) where \( t_{table} = t_{(1-\alpha)(dk)} \) and ignore \( H_0 \) if \( t \) has another value. Degree of freedom \( (dk) = (n_1 + n_2 - 2) \). Based on calculation we get \( t = 9.33 \) with \( \alpha = 5\% \), \( n_1 = 32 \), and \( n_2 = 28 \) we get \( t_{table} = 1.67 \). We obtain \( t > t_{(1-\alpha)(dk)} \), so \( H_0 \) ignored. So, the average mathematical communication ability of students with Knisley Mathematics Learning Model are higher than the average communication ability of students with the Problem-Based Learning model.

Based on the proportion test used to find out the proportion of students' mathematical communication ability with Knisley Mathematics Learning Model is higher than the proportion of students' representation ability with the Problem-Based Learning model. The hypothesis is tested as follows.

\[ H_0: \pi_1 \leq \pi_2 \] (communication ability of the experimental class students were no better than the control class)

\[ H_1: \pi_1 > \pi_2 \] (communication ability of the experimental class students better than the control class)

The test criteria is by testing the proportion of the left with a significant level of 5%, the criterion reject \( H_0 \) if \( z > z_{0.5-\alpha} \). Based on calculation, we get \( z = 1.87 \) and \( z_{0.5-\alpha} = 1.64 \). We obtain \( z > z_{table} \) so \( H_0 \) rejected. So, the proportion of students' mathematical communication ability with Knisley Mathematics Learning Model is higher than the proportion of students' mathematical communication ability with the Problem-Based Learning model.

Based on the results it can be seen that Knisley Mathematics Learning Model is not effective against students' mathematical communication ability. This is because the class of Knisley Mathematics Learning Model does not achieve classical completeness. However, the average and proportion of mathematical communication ability completeness of students who get Knisley Mathematics Learning Model is better than students who get Problem-Based Learning model. In other words Knisley Mathematics Learning Model is higher than Problem-Based Learning model. Not achieving classical completeness in the class using Knisley Mathematics Learning Model is possible because this study was only conducted for 4 meetings. So, it can be predicted if the use of Knisley Mathematics Learning Model
carried out continuously in a long time will achieve classical completeness. This is consistent with the results of previous studies [14-15].

4. Conclusion

Based on the discussion conducted by the researcher, the conclusions are as follows Knisley Mathematics Learning Model is not effective against students' mathematical communication ability. Knisley Mathematics Learning Model was not effective against students' mathematical communication ability because it does not meet the following criteria: students' mathematical communication ability in Knisley Mathematics Learning Model have not reached classical completeness, even though they have met the criteria (a) students' mathematical communication ability with Knisley Mathematics Learning Model is not lower than the average mathematical communication ability of students in the Problem-Based Learning model, (b) the proportion of students' mathematical communication ability Knisley Mathematics Learning Model is not higher than the proportion of students' mathematical communication ability in the Problem-Based Learning model.

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