Improving Students' Mathematical Communication Abilities and Self-Confidence through The Snowball Throwing Learning Model

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ABSTRACT

The purpose of this study is to find out whether the snowball throwing learning model can improve students' mathematical communication skills and self-confidence. This research was conducted in SMP Negeri 2 Cikalongkulon. The research method used was quasi-experimental with nonequivalent control group design. For the experimental class, the treatment was given using the snowball throwing learning model while the control class was given scientific learning. The population in this study were all students of class VII, with a sample of two classes namely class VII C as the experimental class and class VII E as the control class and selected based on the purposive sampling technique. Based on the tests of mathematical communication skills that have been obtained that the improvement of students 'mathematical communication skills using the snowball throwing learning model is better than students who use scientific learning, and based on the self-confidence questionnaire given in the experimental class and control class, it is found that students' self-confidence using the snowball throwing learning model better than students who use scientific learning.

Keywords: mathematical communication skills; self-confidence; snowball throwing learning model

INTRODUCTION

Education occupies a central position in development because the target is to improve the quality of human resources. Tirtarahardja and Sulo (2010) stated that the principle of education implies that education is closely related to the human self and the management of the educational process must take into account scientific developments. Apart from that, the main goal of managing the educational process is to create an optimal learning process and learning experience. In this case, the teacher plays an important role as the implementer of the teaching and learning process so that it really determines the success of education as the results of studies by Buchari (2018) and Asri & Manik (2023) show that learning management will be carried out effectively and efficiently if the teacher is able to do it. his role as manager of instruction in creating learning situations through the use of teaching and learning facilities. This situation also applies to teaching mathematics as a branch of knowledge in the world of education which has an important role as a tool, knowledge, guiding thought patterns and forming attitudes, therefore the mathematics learning process must be carried out well. This is in accordance with Marliani's statement (Mimbarwati, M., Mulyono, M., & Suminar, T., 2023) which states that "mathematics can be used to develop systematic, logical, creative, disciplined thinking skills and effective cooperation in modern and competitive life". This requires teachers to be able to create effective, creative, innovative and efficient mathematics learning with strategies and selecting appropriate learning models and in this case students who study mathematics are expected to have mathematical abilities.

NCTM (2000) suggests five mathematical abilities that students must have, namely: mathematical problem solving, mathematical reasoning and proof, mathematical communication, mathematical connections, and mathematical representation (mathematical representation). Based on the NCTM statement, one of the abilities that students must have is students' mathematical communication skills. Baroody (Lubis, R. N., & Rahayu, W., 2023) emphasized that there are at least 2 important reasons why communication in mathematics learning needs to be the focus of attention, namely that mathematics is a thinking tool for solving problems and as a social activity. In line with that, Greenes and Schulman (1996) also stated that mathematical communication is a central force for students in formulating mathematical concepts and strategies, capital for students' success in approaching and solving mathematical exploration, a forum for students in communicating to obtain information, share thoughts and discoveries and sharpen mathematical ideas.

According to Yulia (Akmila, N, 2022), mathematical communication skills are the expression of mathematical ideas and processes in written or oral form, and can also be interpreted as the ability to convey something in the form of dialogue in which the message is conveyed. Triana, M., Zubainur, C. M., and Bahrun (2019) said that mathematical communication skills are the ability to demonstrate mathematical ideas and symbols both orally and in writing, drawings or diagrams. From these two opinions, it can be concluded that mathematical communication is an event that conveys messages about mathematics to each other verbally or in writing with a specific purpose. Communication is an important part of internal education because the educational process involves two or more individuals, namely the teacher as the transmitter of the message and the student as the recipient of the message and discussion between students is another way to deepen understanding of a concept through social interaction. According to Mahmudi (Saputra & Rahman, 2022) developing effective communication can help students build their understanding of mathematical concepts, thereby facilitating student understanding. Through communication, students can explore their mathematical thinking, knowledge and development in solving problems using developed mathematical language, so that mathematical communication can be formed because communication is an important part of mathematics and mathematics education (Handayani, 2015).

Mathematical communication abilities are closely related to students' self-confidence. This statement is proven by the results of research conducted by Noviyana, Dewi, and Rochmad (2019), that students' mathematical communication abilities will be good if the students have good self-confidence. According to Komara (2016), self-confidence is the initial capital for someone to be able to actualize themselves, develop talents so that they can develop into achievements.

In the process, with mathematical communication skills and self-confidence, students can respond well to the learning process wherever they are. However, unfortunately, most of the results of previous research state that students' mathematical communication skills are relatively low due to students' lack of self-confidence. Students' self-confidence is still weak in communicating, clarifying and convincing the results of their thoughts orally and in writing to their teachers and classmates. To overcome these problems, teachers have an important role in improving students' mathematical communication skills, namely by increasing students' self-confidence.

Lauster (Syam and Amri, 2017) states that self-confidence is an attitude or belief in one's own abilities, so that in one's actions one is not too anxious, one feels free to do things in accordance with one's desires and responsibilities. for his actions, polite in interacting with other people, has a drive for achievement and can recognize his own strengths and weaknesses. One way that can be used to improve students' mathematical communication skills and self-confidence is to use a learning model that can create multi-directional communication activities that are fun and acceptable to students. One alternative learning model is Snowball Throwing (throwing snowballs).

Shoimin (2014) stated that the snowball throwing learning model is a development of the discussion learning model and is part of the cooperative learning model which prioritizes cooperation between students in its application. The communication that occurs in snowball throwing cooperative learning is multi-directional communication which is expected to provide ample opportunities for students to develop their ability to communicate and train students' self-confidence in expressing their ideas or ideas verbally or in writing.

Based on the explanation above, the aim of this research is to find out whether improving students' mathematical communication skills using the snowball throwing learning model is better than scientific learning and to find out whether students' self-confidence using the snowball throwing learning model is better than scientific learning.

RESEARCH METHODS

The method used in this research is the experimental method. The experimental method chosen was quasi-experimental. Quasi experiments are carried out without controlling all variables and subjects are not chosen randomly. The design in this research uses a nonequivalent control group experimental design. This nonequivalent control group experimental design is almost the same as the pretest-posttest control group design, only in this design the experimental group and control group are not chosen randomly (Sugiyono, 2017). This research consists of two variables, namely the independent variable and the dependent variable. The independent variable in this research is the Snowball Throwing learning model which will influence mathematical communication skills and self-confidence as the dependent variable.

The population in this study were class VII students at SMP Negeri 2 Cikalongkulon. Two classes were selected as samples, namely class VII-C for the experimental class and class VII-E as the control class. The number of students in the experimental class was 38 students and the control class was 34 students. The instruments used in this research were tests and non-tests. The test instrument is in the form of pretest questions (initial test questions) and posttest questions (final test questions) to measure the level of students' mathematical communication skills, while the non-test instrument is in the form of an attitude scale questionnaire to measure students' self-confidence towards learning mathematics. The form of test used in this research is a subjective test type in the form of a description in the form of an instrument trial, pretest and posttest consisting of six questions. The scoring of mathematical communication skills is done based on the mathematical communication ability scoring rubric. Before use, the test instrument is tested first to determine the validity, reliability, distinguishing power and difficulty index of each question

item. This instrument test aims to determine the accuracy and reliability of the instrument. Next, based on the pretest and posttest scores, the increase that occurred for each student was calculated using the normalized gain formula (N-Gain).

The non-test instrument used in this research was a questionnaire. In this research, researchers gave questionnaires directly to experimental class and control class students to determine students' self-confident attitudes towards learning mathematics. The questionnaire was prepared based on a Likert scale. The questionnaire given contained 20 statements consisting of 10 positive statements and 10 negative statements.

RESULTS AND DISCUSSION

Mathematical Communication Ability

Pretest data was analyzed to see the similarities in the initial abilities of the experimental class and the control class. For more clarity, see in the Table 1.

Table 1. Descriptive Statistics of Pretest Results Data

Class	Number of Sample	Ideal Score	Lowest Score	Highest Score	Average	Standard Deviation
Experiment	38	24	2	10	4.18	2.415
Control	34	24	1	8	3.32	1.902

Based on Table 1, it can be seen that both classes have relatively the same or equivalent initial mathematical communication abilities. This can be seen from the average values of the experimental class and control class which are almost the same, namely 4.18 and 3.32. The average difference between the experimental class and the control class is 0.86. The lowest scores for the experimental class and control class were 2 and 1, while the highest scores for the experimental class and control class were 10 and 8. The standard deviation for the experimental class was 2.415 and the control class was 1.902.

The normality test is used to determine whether the pretest data comes from a population with a normal distribution or not a normal distribution. The formulation of the hypothesis for testing the normality of pretest data results is as follows:

H_0 : The pretest data sample comes from a normally distributed population.

H_1 : The pretest data sample comes from a population that is not normally distributed.

The normality test is carried out with a significance level of 0.05 with the test criteria namely H0 is accepted if the significance value is ≥ 0.05 and H_0 is rejected if the significance value is <0.05. The results of pretest data processing with the test of normality from Shapiro Wilk are presented in Table 2.

Table 2. Data Normality Test Pretest Results

Class		*Shapiro wilk*		
		N	Sig	Information
Pretest	Experiment	38	0.000	Not Normally Distributed
	Control	34	0.005	Not Normally Distributed

Based on Table 2, the Sig value is obtained. experimental class is 0.000, meaning the significance value is less than 0.05, so H_0 is rejected and the Sig. control class is 0.005,

meaning the significance value is less than 0.05, so H$_0$ is rejected. So it can be concluded that the two samples of pretest data from the experimental class and control class came from populations that were not normally distributed. Because the sample came from a population that was not normally distributed, the test was continued with a non-parametric test (Mann-Whitney Test).

The next statistical test was the Mann Whitney non-parametric test because after carrying out the normality test it was discovered that the two pretest data were not normally distributed. This test was carried out to find out whether the two classes had the same or different initial mathematical communication abilities. The formulation of the hypothesis for the Mann Whitney test is H$_0$: X = Y and H$_1$: X $\neq$ Y with X = Distribution of initial mathematical communication ability scores for the experimental class, and Y = Distribution of initial mathematical communication ability scores in the control class.

The Mann Whitney test was carried out with a significance level of 0.05. The test criteria are that H0 is accepted if the significance value is $\geq$ 0.05 and H$_0$ is rejected if the significance value is < 0.05. The results of the Mann Whitney test assisted by IBM SPSS Statistics version 20 software are presented in Table 3.

Table 3. Mann Whitney Test Results Pretest Data

	Asymp. Sig (2-tailed)	Information
Pretest	0.111	H$_0$ accepted

Based on Table 3, a significance value of 0.111 is obtained, meaning that the significance value of the Mann Whitney test for pretest data is greater than 0.05, so H$_0$ is accepted. So it can be concluded that the average initial mathematical communication ability of experimental class students is the same as the average initial mathematical communication ability of control class students.

The posttest is carried out after students are given treatment. The final ability measured is the student's final mathematical communication ability in learning mathematics with the subject of social arithmetic. Below are presented descriptive statistics of the posttest results for both classes using IBM SPSS Statistics version 20 software.

Table 4. Descriptive Statistics of Posttest Results Data

Class	Number of Sample	Ideal Score	Lowest Score	Highest Score	Average	Standard Deviation
Experiment	38	24	10	20	12.63	2.174
Control	34	24	6	16	10.21	2.739

Based on Table 4, it can be seen that the two classes have different final mathematical communication abilities. This can be seen from the different average values of the experimental class and control class, namely 12.63 and 10.21. The average difference between the experimental class and the control class is 2.42. The lowest scores for the experimental class and control class were 10 and 6, the highest scores for the experimental class and control class were 20 and 16. The standard deviation for the experimental class was 2.174 and the control class was 2.739. After being given treatment in the experimental class and control class, there was an increase in students' mathematical communication

skills. From the results of the posttest, the increase in mathematical communication skills in the experimental class was better than the increase in communication skills in the control class. To find out whether the posttest averages of the two classes are significantly different or not, a statistical test is carried out.

The normality test is used to determine whether the posttest data comes from a population with a normal distribution or not a normal distribution. The formulation of the hypothesis for testing the normality of posttest data is as follows:

H_0: The posttest data sample comes from a normally distributed population.

H_1: The posttest data sample comes from a population that is not normally distributed.

The normality test is carried out with a significance level of 0.05 with the test criteria namely H0 is accepted if the significance value is ≥ 0.05 and H_0 is rejected if the significance value is <0.05. The results of posttest data processing with the test of normality from Shapiro Wilk are presented in Table 5.

Table 5. Posttest Data Normality Test

Class		*Shapiro wilk*		
		N	Sig	Keterangan
Posttest	Experiment	38	0.000	Not Normally Distributed
	Control	34	0.068	Normally Distributed

Based on Table 5, the Sig value is obtained. experimental class is 0.000, meaning the significance value is less than 0.05, then H_0 is rejected and the Sig. the control class is 0.068, meaning the significance value is more than 0.05, so H_0 is accepted. So it can be concluded that the two posttest data samples from the experimental class and control class came from populations that were not normally distributed because one of the classes, namely the experimental class, was not normally distributed. Because the two data were not normally distributed, a non-parametric test was then carried out using the Mann Whitney test

The next statistical test is the non-parametric Mann Whitney test. This test was carried out to find out whether the two classes had the same or different final mathematical communication abilities. The formulation of the hypothesis for the Mann Whitney test is, H_0 : X = Y and H_1 : X > Y with X = Distribution of final mathematical communication ability scores for the experimental class and Y = Distribution of final mathematical communication ability scores in the control class.

The Mann Whitney test was carried out with a significance level of 0.05. The test criteria are as follows:

If the sig value. ≥ 0.05 then H_0 is accepted

If nila sig. < 0.05 then H_0 is rejected

The results of the Mann Whitney test assisted by IBM SPSS Statistics version 20 software are presented in Table 6.

Table 6. Mann Whitney Test Results Posttest Data

	Asymp. Sig (2-tailed)	Information
Posttest	0.000	H_0 rejected

Based on Table 6, a significance value of 0.000 is obtained, meaning that the significance value of the Mann Whitney test for posttest data is smaller than 0.05, so H_0 is

rejected. So it can be concluded that the average final mathematical communication ability of experimental class students is different from the average final mathematical communication ability of control class students.

Data processing on the gain index in the experimental class and control class aims to find out whether the improvement in mathematical communication skills of students in the experimental class is better than in the control class. Below are presented descriptive statistics of the posttest results for both classes using IBM SPSS Statistics version 20 software.

Table 7. Descriptive Statistics of Gain Index Results Data

Class	Number of Sample	Ideal Score	Lowest Score	Highest Score	Standard Deviation
Eksperimen	38	0.26	0.73	0.4316	0.09816
Kontrol	34	0.17	0.56	0.3338	0.11581

Based on Table 7, it can be seen that the average gain index value for the experimental class, namely 0.4316, is higher than the average gain index value for the control class, namely 0.3338, the highest gain index value for the experimental class, namely 0.73, is better than the highest index value. control class gain is 0.56. Based on the explanation above, it can be interpreted that the class that received treatment with the snowball throwing learning model, namely the experimental class, was better than the class that did not use the snowball throwing learning model, namely the control class which used scientific learning. To be able to conclude whether the two classes have increased significantly or not, a statistical test must be carried out.

The normality test is used to determine whether the gain index data comes from a population with a normal distribution or not a normal distribution. The formulation of the hypothesis test for the gain index normality test is as follows:

H_0: The gain index data sample comes from a normally distributed population

H_1: The gain index data sample comes from a population that is not normally distributed

The testing criteria in this research are as follows:

H_0 is accepted, if the sig value. (significance) ≥ 0.05.

H_1 is rejected, if the sig value. (significance) < 0.05.

The results of processing the gain index data with the test of normality from Shapiro Wilk are presented in Table 8.

Table 8. Data Normality Test Gain Index Results

Class		*Shapiro wilk*		
		N	Sig	Keterangan
Indeks	Experimen	38	0.094	Normally Distributed
Gain	Control	34	0.008	Not Normally Distributed

Based on Table 8, the Sig value is obtained. experimental class is 0.094, meaning the significance value is more than 0.05, so H_0 is accepted. So it can be concluded that the experimental class gain index data sample comes from a normally distributed population. Sig value. control class is 0.008, meaning the significance value is less than 0.05, so H_0 is rejected. So it can be concluded that the control class gain index data sample comes from a

population that is not normally distributed. In other words, it can be concluded that the two data samples resulting from the gain index for the experimental class and control class came from populations that were not normally distributed.

The Mann Whitney test of the gain index data was carried out to see whether the gain index data from the experimental class was better than the control class. The formulation of the Mann Whitney Test hypothesis is, H_0: X = Y and H_1: X > Y with X = Distribution of scores for improving mathematical communication skills in the experimental class and Y = Distribution of scores for improving mathematical communication skills in the control class.

The Mann Whitney test was carried out with a significance level of 0.05. The test criteria are that H_0 is accepted if the Sig/2 value is ≥ 0.05 and H_0 is rejected if the Sig/2 value is <0.05. The results of the Mann Whitney Test processing of the gain index data for the experimental class and control class are presented in Table 9.

Table 9. Mann Whitney Test Gain Index Results Data

Gain		Information
Asymp. Sig. (2-*tailed*)	0,001	H_0 rejected

Based on Table 9, the significance value of 0.001/2 = 0.0005 is smaller than 0.05, so H_0 is rejected. So it can be concluded that the improvement in mathematical communication skills of students who use the snowball throwing learning model is better than the mathematical communication skills of students who use scientific learning.

Analysis of Self-Confidence Questionnaire Data

In this research, the non-test instrument used was a self-confidence questionnaire. Data collected from 38 experimental class students and 34 control class students was then sorted based on the order of statements. Student self-confidence questionnaire data is ordinal data so it must be converted into interval data using the Method of Successive Interval (MSI) in Microsoft Excel 2010 software. Below is presented the questionnaire data after being converted into interval data.

Table 10. Description of Self-Confidence Questionnaire for Experiment Class and Control Class

Class	N	Mean	Std. Deviation	Minimum	Maximum
Experimental Questionnaire	38	54.50	8.61	40.90	73.28
Control Questionnaire	34	49.84	8.18	37.77	75.30

After the ordinal data is converted into interval data, parametric calculations are continued.

The population distribution normality test is carried out to determine whether the two classes come from a normally distributed population or not. The significance value obtained is as in Table 11.

Table 11. Self-Confidence Questionnaire Normality Test Results

Class	Shapiro-Wilk
	Sig.
Experimental Questionnaire	0.100
Control Questionnaire	0.064

Based on Table 11, the results of the normality test for the experimental class and control class self-confidence questionnaires show that the significance values are 0.100 and

0.064, respectively, because both classes have significance values of more than 0.05, so it can be concluded that the population distribution of the questionnaire data is normal.

Because the experimental class and control class questionnaire data were normally distributed, a homogeneity test was carried out, namely to find out whether the data from the two groups had homogeneous or inhomogeneous variance. From the calculation results using SPSS Version software. 20 for windows obtained significance values as shown in Table 12.

Table 12. Homogeneity Test Results

Significance	Information
0.479	Homogen

Based on Table 12, the significance value is 0.479 because the significance value is more than 0.05, so based on the test H_0 is accepted, so it can be concluded that the two samples are homogeneous.

Based on the results of the normality test and homogeneity test that have been carried out, data is obtained that is normally distributed and homogeneous so that the test for equality of two averages can be continued using a two-party t test (independent sample test = equal variances assumed). The results of the trial on the similarity of the two averages can be seen in Table 13.

Table 13. Test of Similarity of Two Average Self-Confidence

Asymp. Sig. (2-tailed)	Information
0.022	H_0 Rejected

Based on Table 13, it can be seen that the significance value of 0.022 after dividing by two results to 0.011, which is smaller than 0.05, so based on the test criteria, H0 is rejected. So it can be concluded that the self-confidence of students who use the snowball throwing learning model is better than the self-confidence of students who use scientific learning. Based on the analysis description above, it can be seen that the snowball throwing learning model can significantly improve students' mathematical communication skills and self-confidence. This shows that the increase in mathematical communication skills and self-confidence of students who use the snowball throwing learning model is better than the mathematical communication skills and self-confidence of students who use scientific learning.

CONCLUSION

Based on the research results seen from the gain index data processing, it was concluded that improving students' mathematical communication skills using the snowball throwing learning model was better than students using scientific learning and the self-confidence of students using the snowball throwing learning model was better than that of students which uses scientific learning.

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