REACT strategy toward mathematical communication abilities of madrasah ibtidaiyah students

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Abstract. Mathematical communication skills are one of the important future competencies possessed by students. Based on a preliminary study conducted on students in one of the Madrasah Ibtidaiyah shows that most students have difficulty communicating mathematical ideas. This study aims to figure out students' mathematical communication skills on the subject of the volume of cubes and cuboids for students taught with the Relating, Experiencing, Applying, Cooperating and Transferring (REACT) strategy were better than those who taught with conventional learning. The research method used was a quasi-experimental design of The Nonequivalent Pretest-Posttest Control Group Design conducted on fifth grade students in one of the Ibtidaiyah Madrasahs in Bandung Regency. Based on the results of the study concluded that the mathematical communication skills of students who get learning with REACT strategies are better than mathematical communication skills of students who obtain conventional learning.

1. Introduction
Communication skills are one of the skills developed in 21st century education. Students are trained to be proficient in communicating every idea they have both in oral and written form. In mathematics learning, the Ministry of National Education stated that one of the goals of learning mathematics in elementary is the students can communicate a situation through the ideas or thoughts they have in the form of representations such as symbols, tables, diagrams, or other intermediaries [1]. The ability to communicate mathematical ideas is also an essential standard for the students to be grasped following the opinion of the National Council of Teachers of Mathematics (NCTM). According to NCTM, five basic mathematical competencies become standard abilities in learning mathematics. They are problem-solving, reasoning and proof, communication, connection, and representation [2]. Therefore, we can see that communication abilities are the aptitudes that must be developed and grasped by the students in learning mathematics.

According to Syarifah, Sujatmiko and Setiawan, in learning mathematics, communication is an essential process. Since with the communication, the students can consider and explain their mathematical ideas, along with deliver their thoughts [3]. Mathematical communication skills are one's capability to transfer and receive mathematical ideas both orally and in writing. By understanding students' mathematical communication abilities, the teacher can measure the students' understanding of the material being taught.
Mathematical communication skills in this study seen achievement through written communication. Indicators taken are (1) making connections of objects or pictures in the form of mathematical ideas, (2) making explanations about ideas, circumstances, and mathematical relationships verbally or non verbally in the form of images or other mathematical representations, (3) making statements in mathematical language about an event to explain a situation.

The implementation in the field presented those mathematical communication skills of integrated students in one of the Ibtidaiyah Madrasah in Bandung Regency have not shown maximum results. The researcher gave a six-item description test concerning the volume of cubes and cuboids adjusted to the mathematical communication indicators during the preliminary study. The maximum score for each number was 100. From the tests given, the average score achieved in question number one with an indicator to make the connection of objects or images into mathematical concepts was 61.53. There were obtained 69% of students had results above the average score, and 31% of them had scores below the average.

In question number two, the average score was 61.53. The students who got above the average score were 69% and 31% of students had results below it. The second indicator was to make an explanation of concepts, situations, and mathematical relationships in writing in the form of images. This second indicator was in questions number three and number four. Moreover, the average score for question number three was 28.85 with a percentage of 38% of students who acquired results above the average score, and 62% of students who gained below it. Then, question number four obtained an average score of 23.08 with a percentage of 54% of students got scores above the average score and 46% of students got scores below it.

The third indicator of mathematical communication skills in this study was in questions number five and six, namely making statements in mathematical language about an event to explain something. From the test results, the average score of question number five was 11.54. There were 46% of students who got a score above the average score and 54% of them got below it. The average score for question number six was 7.69 with the percentage of 31% of students’ score above the average score and 69% of them gained below it.

Based on the results of the test, the students’ mathematical communication skills on the first indicator that was making the connection of objects or images into the form of mathematical concepts was quite good but had not shown maximum results. Moreover, the students were expected to improve the indicator to make the description of designs, situations, and mathematical connections in writing in the form of pictures, and indicator to make statements in mathematical language about an event to explain an object.

One of the learning strategies that can be applied to overcome these problems is the REACT strategy. Crawford explains that REACT is an acronym for Relating, Experiencing, Applying, Cooperating, and Transferring [4]. In cooperating activities, there is a process of sharing information that requires the students to communicate their ideas so that their communication skills will develop. The REACT strategy is the development of a contextual learning model.

Mahmud conducted a study entitled "Contextual Learning of REACT Strategies (Relating, Experiencing, Applying, Cooperating, and Transferring) to Improve Students’ Mathematical Understanding Ability". The results showed that the activities of the teacher and the students who implemented the REACT strategy increased at each meeting viewed from the average percentage of the activities. Besides, there were found the differences in students’ mathematical understanding ability between the experimental class and the control class. Furthermore, the attitude of the students in the experimental class and the control class exposed positive results [5]. A similar study was also carried out by Pratiwi with the research title "Application of REACT Strategy to Improve Mathematical Communication Skills of Elementary School Students in the Material of Solid Shapes”. The results showed that the students’ mathematical communication abilities could increase from 74.79 in the first cycle to 80.57 in the second cycle after applying REACT strategy during the teaching-learning process [6].
Based on the explanation above, the researcher desires to conduct a similar study on the application of the REACT strategy. However, the concern of this study is different from earlier studies. In this study, mathematical communication skills will be researched. This research entitled the REACT Strategy on Mathematical Communication Capabilities of MI Students.

2. Methods
The method used in this study was a quasi-experimental method with The Nonequivalent Pretest-Posttest Control Group Design. The independent variable of this research was the application of the REACT strategy, the dependent variable was the mathematical communication ability, and the control variable was the subject of the volume of cubes and cuboids for the fifth grade of MI students. The data sources in this study were integrated students of MI Ar-Rifqi in Bandung district for the fifth-grade students. There were 23 students of group A and 20 students for group B. Furthermore, group B was used as an experimental class that got treatment by applying the REACT strategy in learning. Furthermore, group A was used as a control class that did not get treatment or having conventional teaching-learning process. This research was conducted from 13 February 2019 to 6 March 2019.

The main data in this study was quantitative data sourced from the results of tests of mathematical communication skills by giving pretest and posttest to the students of the experimental class and the control class. Tests were given in the form of six-item description questions about the volume of cubes and cuboids adjusted to the indicators of mathematical communication skills. The indicators of mathematical communication skills used in this study were (1) Creating connections from objects or images into mathematical concepts; (2) Making an explanation of ideas, situations and mathematical connections in writing in the form of drawings; (3) Constructing statements in mathematical language about an event to explain something. Before the pretest and posttest were done, the first test was executed and then it was analyzed through the test of validity, reliability, discriminating power, and the level of difficulty to find out the quality of the questions used in research.

3. Result and Discussion
After conducting REACT strategy in the experimental class and having conventional learning in the control class, a posttest was directed to find the final ability of mathematical communication. After obtaining the results of the posttest from the two classes, the first to do was the normality test and homogeneity test as a prerequisite test.

3.1. Kolmogorov Smirnov One-Sample Normality Test
Normality test was completed to find out whether posttest data has a normal distribution or not normal distribution. The researcher conducted the Kolmogorov-Smirnov One-Sample normality test with a significance level of α = 0.05. The hypothesis was as follows.

\[ H_0: \text{results of posttest mathematical communication skills were normally distributed} \]
\[ H_1: \text{posttest results of mathematical communication skills were not normally distributed} \]

The criterion of judgment was determined if the significance value of P-value \(<\alpha\) (significance level of 0.05) then \(H_0\) was rejected and if the significance value of P-value \(\geq\alpha\) (significance level of 0.05) then \(H_0\) was accepted.

Based on the results of calculations using SPSS 20 software for windows, the results of the posttest data normality test was showed in the following.

| Class     | One-Sample Kolmogorov-Smirnov | Conclusion | Mean                      |
|-----------|------------------------------|------------|---------------------------|
| Experiment 1 | N 20, Kolmogorov-Smirnov Z 0.820, Sig. (2 tailed) 0.512 | \(H_0\) accepted | Normally distributed      |
| Control    | N 23, Kolmogorov-Smirnov Z 0.972, Sig. (2 tailed) 0.302 | \(H_0\) accepted | Normally distributed      |
Based on the Table 1, it could be concluded that the results of the posttest of students’ mathematical communication skills subject to the volume of cubes and cuboids in the experimental class to be tested for Kolmogorov-Smirnov normality have a significance of 0.512 and the control class had a significance of 0.302. Both classes had significance greater than $\alpha = 0.05$ so that $H_0$ was accepted. Thus, the results of the posttest mathematical communication skills in the experimental class and the control class were normally distributed.

3.2. Homogeneity Test
After obtaining the results of the posttest mathematical communication skills in the experimental class and control class that were normally distributed, then the homogeneity test was accomplished. Homogeneity test was completed to find out whether the data variance of the experimental class and the control class analyzed was homogeneous or not. Homogeneity test was carried out by Levene’s test with a significance level of $\alpha = 0.05$. The hypothesis is as follows.

$H_0$: There was no difference in posttest score variance between the experimental class and the control class.

$H_1$: There was a difference in posttest score variance between the experimental class and the control class.

Criterion judgments were determined if the $P$-value $<\alpha$ (significance level of 0.05) then $H_0$ was rejected and if the value of $P$-value of significance $\geq \alpha$ (significance level of 0.05) then $H_0$ was accepted. Based on the results of calculations using SPSS 20 software for windows, the homogeneity test results gained on the posttest data was showed in the following.

| Levene Statistic | Dk1 | Dk2 | Sig. | Conclusion |
|------------------|-----|-----|------|------------|
| 0.268            | 1   | 41  | 0.607| $H_0$ accepted |

Based on the Table 2, the $P$-Value of 0.607 was attained. This value was bigger than the selected $\alpha$ value, which was $\alpha = 0.05$. Because the $P$-value was $\geq \alpha$, $H_0$ was accepted. Thus, the results of testing with Leven’s test software SPSS 20 for windows provided the conclusion that the results revealed no differences in posttest score variance between the experimental class and the mathematical communication abilities of the two classes were homogeneous.

3.3. The Average Difference of Posttest Score of Mathematical Communication Ability
After getting the results of the posttest mathematical communication skills in the experimental class and the control class which were normally distributed and homogeneous, then the t-test or independent t-test was executed. T-test was conducted to find the differences in mathematical communication skills of the experimental class and the control class from the posttest results achieved. Under the research hypotheses that had been made, the one-tailed hypothesis was used. The hypothesis was as follows.

$H_0$: There was no difference in the average posttest score of mathematical communication skills of the students who achieved mathematics learning with the REACT strategy with the students who got conventional learning.

$H_1$: The average posttest score of mathematical communication skills of the students who achieved mathematics learning with REACT strategy was better than the students who got conventional learning.

Criterion judgments were determined if the significance value of $P$-value $<\alpha$ (significance level of 0.05) then $H_0$ was rejected and if the significance value of $P$-value $\geq \alpha$ (significance level of 0.05) then $H_0$ was accepted.

Based on the results of calculations using SPSS 20 for windows software, the results of the posttest data t-test in the following.
Table 3. T-Test Posttest Score Mathematical Communication Skills

|   | t  | df | Sig. (2 tailed) | Conclusion |
|---|----|----|----------------|------------|
|   | 2.11 | 41 | 0.041 | H₀ rejected |

Based on Table 3 it could be seen that the t-count for the scores of the two groups with homogeneous data was 2.112 and the significance (2 parties) was 0.041. The P-value obtained was divided into two because this study used a one-party test. The P-value obtained was 0.041/2 smaller than α = 0.05, then H₀ was rejected. This means that at 95% confidence level it could be established that the average posttest score of mathematical communication skills of the students who got mathematics learning with REACT strategy was better than the students who took conventional learning.

Based on the analysis that has been done on the results of the posttest mathematical communication skills in the control class and experimental class, the results obtained using mathematical communication of students who obtain learning with REACT strategies are better than mathematical communication skills of students who obtain conventional learning. In the learning process by applying the REACT strategy, students get stimuli to be actively involved in the learning process through Relating, Experiencing, Cooperating, and Transferring activities. This is in accordance with the results of Nugraha, Nindiasari, and Syamsuri’s research related to learning through the REACT strategy which contributes well in efforts to improve students’ mathematical communication skills. This is possible because learning has changed the paradigm of teacher-centered learning towards learning that supports active students who construct their own knowledge. [7]

In relating or connecting activities, the teacher makes connections between the concepts learned and those that are close to student life. According to Suherman, mathematics does not accept generalization based on observations (inductive), but must be based on deductive proof. In the learning process of the volume of cubes and beams, students are not immediately given an abstract formula, but the teacher starts by linking students' knowledge about cube-shaped objects and blocks that are around students. According to Sugandi and Akbar, students are given the opportunity to connect the knowledge and concepts they have just learned with the knowledge and concepts that have been taught or pre-existing, through the method of giving students questions in an effort to build student ideas, phenomena or objects regarding learning material presented through the activities of seeing, observing, reading, listening, listening and connecting. [8]

Then, the teacher gives up the cubes / blocks and also the unit cubes. Through this activity, students are trained to communicate their ideas about the relationship between unit cubes and building cubes / blocks. This activity is a process of experiencing students in finding the volume formula for a cube and also a block. In experiencing activities, students experience for themselves how a concept is formed. Students gain new knowledge by building concepts that are learned through the process of exploration, discovery and invention. Muin and Isneni explain the stages of experiencing supported by the proposition of construction in Bruner's learning theory which states that if students want to have the ability to master an idea, then the student must be trained to try and do it themselves so that he better understands the concepts of the material being studied. [8]

The process of applying the concepts that have been known through experiencing activities is then applied in the form of work on mathematical communication skills. In applying activities, students practice to communicate an explanation of an idea, condition, and mathematical relationship in writing as outlined in an image from the calculation of the volume of a cube and a block. In addition, students are able to compile a statement in mathematical language to explain the problems that occur in calculating the volume of cubes and beams. Work on this question is done cooperatively. In line with the opinion of the Association for the Advancement of Science [4], the best learning process occurred when the students had the opportunity to express their ideas and get feedback from their peers. In these groups, the students could exchange their ideas and freely convey the arguments they had and they were
educated to accept the thoughts of others who might be different from their thoughts. By accepting the thoughts of others, the students could enrich their knowledge. Moreover, Arifi, Kartono, and Sutarto explain interaction with the environment allowed the students to improve their understanding and enhance their knowledge through question-answer activity, and discussed the issues with their study groups [8]. The next activity was transferring. In transferring activities, the students must be able to use the newly acquired knowledge in dealing with new contexts or situations provided by the teacher. The new situation of transferring stages means that the teacher provided evaluation questions to test the students’ understanding of the concept from the delivered material.

The activities contained in the REACT strategy were certainly not found in learning in the control class that practiced conventional learning. In conventional learning, the activities started by observing objects around the students in the form of cubes and cuboids. Then, offered the students to ask questions. Furthermore, the teacher explained the learning material, after that she/he delivered individual practice questions and then discussed them together. In transferring activities, students must be able to use the newly acquired knowledge in dealing with new contexts or situations. Students can transfer the knowledge they have to friends from other groups.

The learning process that occurred in the control class by applying conventional learning was still less effective in improving communication skills because in conventional learning was still teacher-centered and the students were less actively involved in the learning process. The students did not discover their new knowledge but directly explained by the teacher. Besides, the students completed the tasks individually, so there was no process of exchanging knowledge from other friends.

4. Conclusion

Based on the results of the research it can be summed up that the students who learn with REACT strategy achieve better communication abilities than those who apply conventional learning model. Furthermore, the REACT strategy influences students’ mathematical communication skills. This occurs because when the students participate in learning with the REACT strategy, they work in a group so that communication is established both orally and in writing.

5. References

[1] Depdiknas 2001 Kurikulum Berbasis Kompetensi Mata pelajaran Matematika Sekolah Dasar
[2] NCTM 2000 Principle and Standards for School Mathematic (USA: NCTM)
[3] Syarifah T J, Sujatmiko P, and Setiawan R 2017 Analisis Kemampuan Komunikasi Matematis Tertulis Diinjau Dari Gaya Belajar Pada Siswa Kelas XI MIPA 1 SMA Batik 1 Surakarta Tahun Pelajaran 2015/2016 Journal Pendidikan Matematika dan Matematika (JPMM) pp 1-19
[4] Crawford M L 2001 Teaching Contextually (Texas: CCI Publishing)
[5] Mahmud M R 2011 Pembelajaran Kontekstual Strategi REACT (Relating, Experiencing, Applying, Cooperating, Transferring) untuk Meningkatkan Kemampuan Pemahaman Matematis Siswa Thesis (UIN Sunan Gunung Djati Bandung)
[6] Pratiwi I M 2014 Penerapan Strategi REACT untuk Meningkatkan Kemampuan Komunikasi Matematis Siswa Sekolah Dasar Materi Bangun Ruang Sederhana Thesis (Universitas Pendidikan Indonesia Bandung)
[7] Nugraha T H, Nindiasari H, Syamsuri 2019 Pengaruh Strategi Pembelajaran REACT Terhadap Kemampuan Komunikasi Matematis Siswa SMP Berdasarkan Gender Pasundan Journal of Research in Mathematics Learning and Education (p.16)
[8] Sugandi A I and Akbar P 2019 Evektifitas Penerapan Strategi REACT Terhadap kemampuan Koneksi Matematis dan Self-Efficacy Siswa pp 423-430
[9] Arifin A T, Kartono, and Sutarto, H 2014 Keefektifan Strategi Pembelajaran REACT Pada Kemampuan Siswa Kelas VII Aspek Komunikasi Matematis Kreano pp 91-98
[10] Muin A and Isneni F 2012 Strategi REACT dalam Mengembangkan Kemampuan Berpikir Kreatif’ Matematis Prosiding Seminar Nasional (p. 1) (Bandung: Universitas Pasundan)