Application of react (relating, experiencing, applying, cooperating, transferring) strategy to improve mathematical communication ability of junior high school students

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Abstract. This present study aims at studying whether react strategy improve students’ mathematical communication ability. Research design used in this is quasi-experimental. Information obtained from the article is then compiled into a writing. The results of this study indicated that the REACT strategy improve students’ mathematical communication skills of junior high school. Learning mathematics with the REACT strategy can be used as a test recommendation to see how and how much the picture of communication skills in mathematical concepts can be improved.

1. Introduction

Mathematics is a lesson that has an important role in shaping the character of students. Its learning objectives, namely (1) improving intellectual abilities, especially the ability of high-level thinking students; (2) form students’ ability to solve a problem systematically; (3) obtaining high learning outcomes; (4) training students in communicating ideas, especially in writing scientific work and (5) developing student character [1]. From the five goals, one of the important things in learning objectives is training students in communicating ideas. It means that communication skills are very necessary for students. Various studies have been conducted from all components of learning to grow and improve mathematical communication skills. Learning that is carried out must be based on student-centred, thus giving students the opportunity to be active in learning. Students no longer rely on the teacher as the only source of learning, but students must also be able to learn independently in completing their academic assignments. One of them is in the components of learning media such as interactive multimedia. In order for these problems to be overcome and it is expected that mathematical communication skills can be improved, a mathematical learning strategy is needed in accordance with teaching materials that can interpret a learning process, because mathematics learning is an arena for students to connect a problem and ability, one of the abilities the mathematics teacher must have is able to demonstrate the application of various teaching methods and techniques in the field taught [2]. Many techniques, strategies and learning models can be applied by the teacher. One of them is the strategy of relating, experiencing, applying, cooperating, and transferring (REACT).

REACT is one of the learning strategies based on constructivism. In other words, REACT learning strategies are learning strategies that can be used to activate students in building their own knowledge. In building their own knowledge, students are required to interact with their environment [3].
2. Method
As this study aims at identifying whether react strategy improve students’ mathematical communication ability, it is proper to use quasi-experimental design. The class divided into control class and experimental class. The experimental class retained react strategy while control class received lecturing method. Before having treatment both classes were tested in pre-test form. This becomes starting point to identify of both group. The treatment conducted into five meetings as consideration to have validity. The data also obtained through testing-post-test. The data then were analyzed to have some tests like normality test, homogeneity test, effect size test, t-test and n-gain analysis test [4].

3. Result and Discussion
3.1. Mathematical Communication Ability
Communication is the process of expressing ideas or ideas and mathematical understanding using numbers, images, and words, in a variety of communities including teachers, peers, groups, or classes. It is also revealed that mathematical communication is a way to share ideas and clarify understanding of learning mathematics [5]. In mathematical communication, ideas come from the problem solving process to be the object of reflection, refinement, discussion, and change [6]. When students are challenged to solve problems, they will have the opportunity to think and try to solve them. Students' difficulties in solving problems, different ideas, and different solutions are potential resources that encourage students to share, compare, justify, explain, or discuss the problem. Interaction between students during all classroom activities provides an opportunity to develop their mathematical abilities including conceptual and procedural understanding [5]. Student interactions in which mathematical ideas are explored from different points of view can help students to deepen their understanding, and develop their ability to communicate, explain, justify, and discuss mathematical ideas.

The ideal teacher equips his/her students learn by not prioritizing answers but how to reflect, characterize, and discuss problems, and how they take their own initiative, form or find valid answers [7]. In this case students are required to carry out investigations where they formulate problems, plan the completion and interpretation of information, conclude answers, communicate what they have learned, and formulate the expansion of the problem. So in this case mathematical communication skills are important things that students must have. In addition, Isoda proposed several components of mathematical communication, namely: (a) Using appropriate language to promote conceptual understanding and discourse; (b) Emphasizing logical reasoning; (c) Distinguish between conceptual explanations and procedural descriptions; (d) Making meaningful representations; (e) Growing sympathy. The importance of mathematical communication is listed in the mathematics learning goals as outlined in the following mathematics competency standards: (a) Practicing thinking and reasoning in drawing conclusions, for example through investigation, exploration, experimentation, shows similarities, differences, consistency and inconsistencies; (b) Developing creative activities that involve imagination, intuition, and discovery by developing divergent thinking, originality, curiosity, making predictions and predictions, and experimenting; (c) Developing problem solving skills; (d) Developing the ability to convey information or communicate ideas, among others, through verbal talks, graphics, maps, diagrams, in explaining ideas.

The NCTM Principles and Standards also highlight the importance of communication as an important part of mathematics and mathematics education. Through communication an idea becomes the object of reflection, refinement, discussion and change, and this is the process that helps build meaning and establish ideas, and makes the idea generally valid [6]. Emphasis on the importance of communication in mathematics, also poured in the 2013 curriculum. The formulation of attitude, knowledge and skills competencies used in the 2013 curriculum emphasizes the importance of creativity and communication.

Craven (2000) provides his support for emphasizing students' mathematical communication, providing ideas for recording and sharing learning (for example, journals, reports, posters, letters, stories, three-dimensional models, sketches / drawings with explanations, oral presentations) [8]. He concluded by stating that students must feel free to explore, speak, make, and write about mathematics in a classroom environment that respects the beauty and importance of the subject. Students must be
empowered to take risks and be encouraged to explain their thoughts. The teacher must build assignments that will generate discussion and provide opportunities for students to explain their mathematical concepts through pictures, words and numbers. In this way, children can become proficient and articulate in communicating mathematical ideas.

At the first time the pre-test used mathematical communication problems, each question represented an indicator of students' mathematical communication abilities. It turns out that when conducted in control and experimental classes, the average student is still low. The control class got an average of 56.2% while the average in the experimental class was 61.2%. This means that the average mathematical communication skills of middle school students is still low. Then try the REACT strategy in the experimental class, and conventional learning in the control class.

3.2. Learning Strategies REACT (Relating, Experiencing, Applying, Cooperating, and Transferring)
This REACT strategy is a series of student activities in relating material to everyday life, experiencing, applying, collaborating and transferring the knowledge that has been gained to solve problems in real-world life. Learning with REACT strategies will provide many learning experiences to students because: 1) learning is defined as lifelong learning (learning through of life), 2) students learn by exploring their own information and technology that they need actively, both individually and in groups to build knowledge, 3) students not only master the contents of their subjects but they also learn how to learn (learn how to learn) [9]. The application of REACT learning strategies focuses on student-centred learning because students are really required to be active in constructing their own knowledge. At the beginning of learning with the REACT strategy implemented in the experimental class, students are still unfamiliar. Because this strategy affects every thought and way of student learning. This can be explained as follows:

3.2.1. Relating (linking or connecting)
In learning students see and pay attention to the state of the environment and events in everyday life, then linked in new information or problems to be solved [10]. Relating is learning that begins by linking new concepts that will be studied with new concepts that have been taught or pre-existing [9]. Forms of learning in real life contexts or real experiences. Learning must be used to connect everyday situations with new information or problems to solve. Relating as a tool for presenting situations closer to students and developing a deep understanding of certain concepts [10].

Teachers are said to use the relating strategy, when students associate a new concept with something that is really familiar to students. This can be interpreted by linking what students already know with new information. In its implementation, the teacher begins learning by asking questions or problems that can be answered by almost all students based on their experience outside the classroom [11]. So, the questions asked are always in phenomena that are interesting and familiar to students, not conveying something abstract or phenomena that are beyond the reach of students' perceptions, understandings, and knowledge.

The first step of learning with the REACT strategy is to connect with everyday events, this intends so that students can better understand for what the material must be mastered, and what are the benefits of learning the material. At this step, students begin to learn how to relate a material to daily life. During learning takes place, each meeting students experience an increase in the process of connecting with everyday life. This can be seen on the student observation sheet conducted by researchers every day in mathematics.

3.2.2. Experiencing (experiencing)
Experiments are obtained with students experiencing first-hand the things they learned. Through this step, students can explore understanding through discovery [10]. If students do activities say and do, students will be able to remember 90% of what they say and do (experience) themselves [11]. So what is experienced by students in the class is very influential on students' understanding in mastering the concept of lessons that have been delivered by the teacher because in general students build knowledge of new concepts learned more meaningful if students experience directly. The experiencing step can help students to build new concepts by concentrating experiences that occur in the classroom through exploration, discovery, and projects. This experience can include the use of manipulation,
problem solving and activities in the laboratory. Constructivism in general is not applied to activities that teachers should not explain the practicum, but involve students in finding knowledge through their experience Bransford et. al in [9]. Manipulation can be applied by using simple objects that students can hold and move and feel as concrete models of abstract concepts. This activity also teaches problem solving skills, analytical thinking, communication, and group interaction. In the experiencing step, students work in small groups to collect data by making measurements, analyzing data, conclusions and estimates, and illustrating the main concepts involving these activities [9].

At this step, students also experience an increase. From the beginning of the meeting until the end of the meeting where the attitude of students when exploring from only 52% to 80%. This can be seen at the exploration step, students are always eager to explore themselves and in solving problems.

3.2.3. Applying (applying)
The applying strategy is to learn to apply concepts and information in meaningful contexts. Learning is done is to learn to apply concepts when carrying out solving activities of questions, both through worksheets, assignment exercises, and other activities that involve the activity of students in learning. To be more motivated in understanding concepts, the teacher can provide exercises that are realistic, relevant, and show benefits in a field of life [9]. Applying is a strategy in a context that develops deeper meaning, namely the reason for learning.

At this step students do not experience much improvement at each meeting. Initially at the application step many students were familiar with this concept. The percentage of students who can apply the material is 70%, then at the end of the meeting an increase but not too significant that is equal to 82%.

3.2.4. Cooperating
Cooperating is a learning process where students learn to share (share) and communicate with other students. Learning by collaborating, exchanging opinions (sharing), responding, and communicating with other learners will greatly help students in learning a concept [9]. Learning activities that are relevant to cooperative learning are group work and group success depending on the performance of each member. Teachers are tasked with forming effective groups, giving appropriate tasks, being observant observers during group activities, diagnosing various problems quickly, and providing information or instructions needed [9]. The experience of working together not only helps students learn to master subject matter, but also provides insight into the real world [12].

At this step it is very influential on student communication, both on the material and with peers. The average student at this step is very significant. This is because the learning that teachers usually teach is very common with one-way communication, that is, most teachers only speak. While at this step students must be able to discuss with their friends. From student observation data from an average of 50% to 98%.

3.2.5. Transferring (transferring)
Transferring is described as the use of knowledge in a new context or situation where someone has never done it in class. Learning is directed at analyzing and solving a problem in everyday life in the environment by applying the knowledge that it already has. In this learning the teacher is required to design tasks to achieve something new and diversity so that the goals of interest, motivation, involvement and mastery of students towards mathematics can increase [9]. This strategy emphasizes the ability of students to transfer the knowledge, skills and attitudes they have in other situations [12]. In other words, the knowledge and skills that students already have are not just memorized, but can be used or transferred to other situations or conditions. Students' ability to apply the material they have learned to solve new problems is the mastery of cognitive strategies or "achievement of learning objectives in the form of finding (finding)" [12]. In its implementation, the teacher has the natural ability to introduce new ideas that can intrinsically motivate students by provoking curiosity. Therefore, teachers effectively use questions to provoke curiosity and motivation in transferring knowledge from one context to another [11].

At this step students are very enthusiastic. At this step students can explain the results of work with their group friends who are then well presented. At this step the researcher can assess students' ways of
thinking, students' mathematical communication ways, and can assess students' collaboration with their groups. Then other students can get knowledge from their peers. Although in this process there are still many students who are embarrassed, but after being given a stimulus, students finally dare to express what has been done by the group. At this step, there was an increase in each meeting, from 48% of active students to the end of the meeting to 85% of active students. This can be seen from the width of student observation.

The advantages and disadvantages of the REACT strategy are as follows [9]: The advantages of REACT strategies include: a) deepening student understanding; b. develop self-respect for students and others, c) develop an attitude of togetherness and a sense of belonging; d) develop skills for the future; e) forming an attitude of loving the environment; and f) make learning inclusive. The shortcomings of the REACT strategy include: a) the time required tends to be long; b) requires special teacher skills; and c) demand certain characteristics from the teacher.

After conducting the pre-test then several meetings, the average result of the mathematical communication skills of the control class students was 62.8%, which at the beginning at the pre-test was only 56.2%. Then in the experimental class also experienced an initial increase in pre-test only by 61.2% to 91.3% at the post-test.

From this number, the n-gain is tested. After checking that the data is normally distributed and homogeneous, then using the t test. then the result is a significant increase in difference between the pre-test and post-test scores in the experimental class. These results can be seen in Table 1 below.

Table 1. Initial Situations and Changes in Students in Experimental and Control Classes

| Group  | Test Category | Percentage of the value of students' mathematical communication skills |
|--------|---------------|---------------------------------------------------------------------|
| Control| Pre-test      | 56.2%                                                               |
|        | Post-test     | 62.8%                                                               |
| Experiment| pre-test   | 61.2%                                                               |
|         | Post-test     | 91.3%                                                               |

Based on the data shown in Table 1, it was revealed that students' communication skills increased significantly when the results of the post-test and pre-test on mathematical communication skills were compared. The existence of a significant percentage increase in this experimental class revealed that learning mathematics with the REACT strategy can improve mathematical communication skills. The results of other studies that are similar to the results of the studies reviewed and analyzed revealed the existence of a positive relationship between REACT strategies that are used as learning strategies towards improving mathematical communication skills [13]. The results of other studies indicate that there is an influence between the improvement of students' mathematical communication skills through the REACT strategy, because in the REACT strategy there is a transferring process that emphasizes the ability of students to transfer the knowledge, skills and attitudes they have in other situations [14]. This informs us that the use of REACT strategies in learning can improve mathematical communication skills. The results of other studies that are similar to the results of the research that were reviewed and analyzed showed a positive relationship between the REACT strategic used as a learning strategy towards improving mathematical communication skills [13]. Reaction, because in the REACT strategy is a transfer process that requires students' ability to transfer the knowledge, skills and attitudes needed by students. In other situations [14]. This tells us about strategies for using REACT in learning to improve mathematical communication skills. this is because the REACT strategy has stages that can build student communication, for example at the apply stage here it can be seen that students are able to apply the language of mathematical communication from their thinking to a symbol in mathematics, then at the cooperating stage students work together with a group of friends which means communication between students also must be good. At the transfer stage, students present the results of their discussions to their classmates. From here it can also be seen that this stage is able to improve its communication capabilities.

This is in line with Musna's research, entitled Improving Students' Mathematical Communication Capabilities through Learning Strategies (REACT) in MTs / Junior High School Students. This
research was conducted in Nagan Raya, Aceh, Indonesia on Mathematics subjects with set material. The study population was class VII students who then took a sample of 63 people from the population. This study included quasi-experimental research with pretest-posttest control group design. Based on the design, the study was conducted in two groups which included the experimental class and the control class. 63 samples were described above, then divided into experimental and control groups. The experimental class was treated with the use of REACT strategies in mathematics learning. While the control class was given traditional learning treatment.

This research was conducted by means of observations in terms of the learning process carried out and the provision of written tests. Based on the results of observations and written tests, it can be seen whether or not there is an increase in students' mathematical communication skills. The steps of research are used, as follows: 1) pretest mathematical communication skills of students, 2) students are divided into several class, 3) students are given student worksheets (LKS) to help understand the learning process, use REACT strategies to motivate students and find relation between mathematical concepts and real life during learning, 4) investigating the ability to understand students 'mathematical concepts related to real life by giving written tests, and 5) doing post-test on students' mathematical communication skills [9]. The results of the research conducted by Musna were then reviewed and analyzed by combining the results of these studies with the results of other studies which were similar where research orientation was seen in terms of improvement.

In addition, other studies revealed that learning curved space-building material using REACT strategies was significantly more effective in improving students 'mathematical communication skills and students' critical thinking skills compared to conventional learning [15]. Students give positive (good) responses to mathematics learning using the REACT strategy. Students showed a feeling of happiness towards mathematics through learning using the REACT strategy, showed interest in the process and results contained in the REACT strategy, and showed seriousness in learning the material to construct curved side spaces using the REACT strategy [15].

4. Conclusion
Theoretically, the use of REACT strategies in mathematics learning can improve students' habits in analyzing real-life phenomena and leave long-term memories in students after learning. Students can do an analysis if they have the ability to communicate mathematical concepts related to the phenomenon. REACT strategy can be used as a strategy in mathematics learning to grow and improve mathematical communication skills of students' concepts into conclusions in this study.

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