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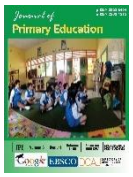

The Effectiveness of Auditory, Intellectually and Repetition Learning with RME Approach to Students Mathematical Communication Ability

Nur Ilmia Nisarohmah [1]✉, Rochmad Rochmad [2], Isnaini Rosyida [2]

[1.] Universitas Islam Negeri Walisongo, Indonesia
[2.] Pascasarjana, Universitas Negeri Semarang, Indonesia

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Abstract

Mathematical communication ability is the ability to model mathematical forms, explain and make questions, and develop arguments. Auditory, Intelectually, and Repetition (AIR) learning facilitates to improve students' mathematical abilities. The purpose of this study was to analyse the effectiveness of auditory, intellectually, repetition learning with a Realistic Mathematics Education (RME) approach on students' mathematical communication ability. This research uses mixed methods with sequential explanatory design. The sampling technique is used by means of cluster random sampling. Data obtained by using the test method, interviews, and observations. Quantitative data analysis was carried out using the t test, the mean difference test, and the proportion test. Based on the results of the study, it shows that the mathematical communication ability of students who use AIR learning with the RME approach on average reach the actual completion limit and classical completion. Students who use auditory, intellectually, repetition learning with a realistic mathematics education approach have better mathematical abilities than students who are taught using problem-based learning. The ability to present sketches, use mathematical notation, then complete and conclude correctly are performed by high mathematical communication skills students. For students with moderate mathematical communication skills, they are quite capable of sketching pictures, applying mathematical notation. Then, students who have low mathematical communication skills are quite capable of sketching pictures, writing mathematical notation. So, it can be concluded that the application of AIR learning with RME approach is effective on students' mathematical communication ability than PBL learning.

✉ Correspondence address:
Jl. Walisongo No.3-5, Tambakaji, Kec. Ngaliyan, Kota Semarang, Jawa Tengah
E-mail: nurilmianisarohmah@gmail.com

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INTRODUCTION

Education is a conscious and planned effort to create a learning atmosphere and the learning process of students to develop their potential so that they have religious spiritual strength, self-control, personality, intelligence, noble character, and skills. So that education has a very important role to develop the potential of human resources so that it can be useful in the lives of both individuals and community groups . Curriculum 2013 learning is competency learning with authentic learning and assessment processes to achieve attitude, knowledge, and skill competencies. Strengthening the learning process can be carried out through a scientific approach, namely learning that encourages students to be more capable of observing, asking questions, trying/collecting data, associating/reasoning, and communicating (Maulina, Puspita, & Usman, 2018).

One of the fields of study that has an important role in the world of education and in dealing with the problems of everyday life is mathematics. Mathematics is a basic science that is needed to support success in taking education levels, ranging from elementary, secondary to higher education levels that must be mastered by every student. Therefore mathematics is a subject that is given to all levels starting from elementary school (Mustika & Kinanti, 2018).

To solve mathematical problems, it is very important to have good mathematical communication skills. Mathematical communication skills are the ability to express mathematical ideas and understanding orally and in writing using numbers, symbols, graphs, diagrams or words (Vinet & Zhedanov, 2017). Mathematical communication is a basic mathematical ability that needs to be possessed by high school students. Mathematical communication plays an important role in building students' mathematical concepts so that students can associate ideas or language with mathematical symbols properly and correctly (Swasti, Maimunah, & Roza, 2020).

Indicators of mathematical communication ability are: (1) expressing real objects, situations and everyday events in the form of mathematical models (pictures, tables, diagrams, graphs, algebraic expressions); (2) explain mathematical ideas and models (pictures, tables, diagrams, graphs, algebraic expressions) into ordinary language; (3) explain and make mathematical questions learned; (4) listening, discussing and writing about mathematics; (5) read with understanding a presentation; (6) make conjectures, construct arguments, formulate definitions and generalizations (Fitria & Handayani, 2020).

Based on the observation it was found that students have difficulty in connecting problems into mathematical form. The difficulties faced by students are not being able to explain ideas mathematically, connecting mathematically with real objects, pictures, graphs, and algebra, evaluating and not being able to express answers to problems by making conclusions. On the subject matter of straight-line equations, it is found that many students worked on the questions given by the teacher with a direct formula but were not correct in sketching the problems given. The question given is "The sides of the square ABCD are parallel to the coordinate axes. The points A(1,-2) and C(5,1) are opposite vertices; (a) Sketch the square ABCD; (b) What is the equation of the line that passes through points B and D? The answer of one student is displayed in Figure 1.

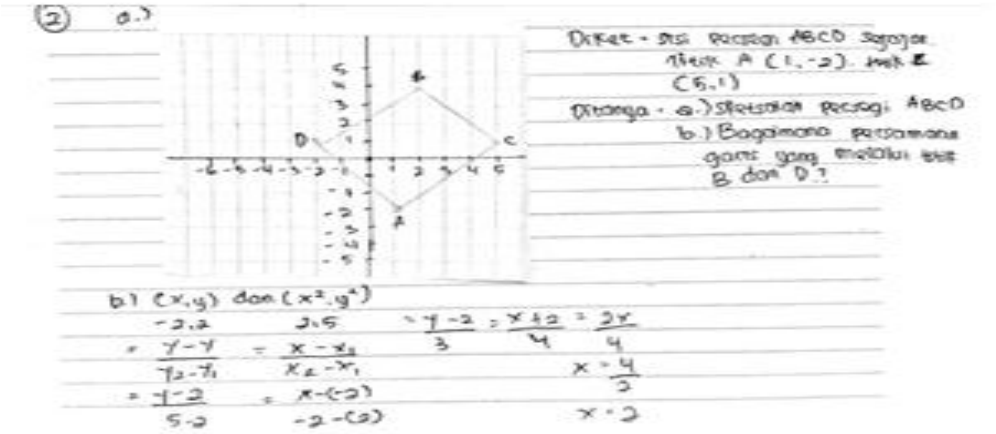

Figure 1. The Result of Student

Based on Figure 1, it shows that students have poor communication ability. In these problems, students are less able to explain ideas, situations and mathematical relationships with real objects, pictures, graphs, and algebra, are less able to state and evaluate everyday events in mathematical language or symbols, the ability to communicate answers to problems in the form of conclusions. One of the factors that affect mathematical communication ability is the application of learning methods.

According to the problem of students' mathematical communication ability, the researchers provided a solution by applying Auditory Intellectual and Repetition (AIR) learning with a Realistic Mathematics Education (RME) approach. The auditory intellectually and repetition learning is effective in supporting students to build their own or group knowledge, this is because students can take advantage of these three things, namely auditory intellectually and repetition. Auditory, intellectually, and repetition learning can increase students' accuracy in solving problems. The teacher's AIR learning can provide opportunities for students to solve problems so that students can be motivated and increase student activity in learning activities (Zulherman, Arifudin, & Pratiwi, 2020). Auditory intellectually and repetition learning can train students' critical thinking skills in solving problems (Bulu, Dharmadewi, & Wiadnyana, 2021).

The RME approach is learning that is carried out in interaction with the environment, and starts from real or imagined problems by students and emphasizes process skills in solving problems (Mulyati, 2017). In the realistic mathematics education approach, students are directed to think openly. The use of the approach is also effective than conventional mathematics learning (Noviani & Firmansyah, 2020). The results of previous studies showed that there was an increase in students' mathematical communication after using a realistic mathematical education approach (Rusmiati & Ruqoyyah, 2021). Using real problems in everyday life as the initial basis for students in learning mathematics so that learning will be more meaningful (Sumirattana, Makanong, & Thipkong, 2017). The purpose of this study was to determine the effectiveness of learning AIR with the RME approach on students' mathematical communication ability.

METHOD

This research uses mixed methods research with sequential explanatory design. The population in this study were students of MTs N 1 Semarang City. Then the classes that were used as samples were class VIIIA and VIIIB which were selected by cluster random sampling. Class VIIIA was used as the experimental class and class VIIIB as the control class. The research variables are AIR learning as the independent

variable and mathematical communication skills as the dependent variable. The research design table provided in table 1 as follows.

Table 1. The Design of Research

Class	Pretest	Treatment	Postest
Experimental Class	T_1	X	T_2
Control Class	T_1	Y	T_2

Note:
X: AIR learning with RME approach.
Y: PBL Learning.
T1 : Mathematical communication ability pretest.
T2 : Mathematical communication ability posttest.

In the experimental class, treatment was carried out using AIR learning with an RME approach and the control class using problem-based learning (PBL). Data were obtained by using mathematical communication skills tests, observations, and interviews. Quantitative data analysis used t test, average difference test, and completeness proportion test. Meanwhile, qualitative data used technical triangulation and source triangulation.

Subjects were selected based on mathematical communication ability, namely, two categories of high, medium, and low were selected. The indicators of students' mathematical communication skills consist of 5 indicators that are measured, namely (1) the ability to connect real objects, pictures, and diagrams into mathematical ideas; (2) the ability to use terms, mathematical notations, and structures; (3) the ability to explain ideas, situations, and mathematical relationships in writing with real objects, pictures, graphs, and algebra; (4) the ability to express and evaluate everyday events in mathematical language or symbols; (5) the ability to communicate answers from problem in the form of a conclusion.

The AIR learning stages consist of (1) Auditory stages, namely listening, listening, speaking, presenting, arguing, expressing opinions, and responding, (2) the stage of intellectually, at this stage students use the ability to think, concentrate, reason, investigate, identify, find, create, construct, solve problems, and apply, (3) Repetition stage, at this stage students deepen, expand, strengthen by means of students being trained through giving assignments or quizzes.

RESULTS AND DISCUSSION

Based on the results of the analysis using the t-test, it is obtained tvalue=12.8 and significance level of $(\alpha) = 5\%$ obtained a value of t (1-5%)(30-1)=1.7, because 12.8>1.7 the means H1 of acceptance. So, the average test results of students' mathematical communication ability taught by using auditory, intellectual, and repetition learning with an RME approach reached more than the actual complete limit, namely 64.5.

This finding is in line with the results of the study which showed that the mathematical representation ability of students who obtained the auditory, intellectually, and repetition learning reached the actual limit of completion (Risdianti, Kartono, & Masrukan, 2021). Students who are taught using the RME approach have good learning outcomes and motivation to learn (Hasan, Pomalato, & Uno, 2020). The results of other studies show that the RME approach that is packaged by providing contextual problems will allow students to find different solutions (Arisinta, As'ari, & Sa'dijah, 2019). Several previous studies that apply the auditory, intellectually and repetition learning model completely (Luthfiana & Wahyuni, 2019). In line with the results of previous studies that students who are taught the auditory,

intellectually, and repetition learning, student learning outcomes are classically complete (Resyani, 2021).

Student learning outcomes after applying auditory, intellectually, and repetition learning are significantly complete, this is evidenced by the average test has increased (Aprilliah, Luthfiana, & Wahyuni, 2019). This research is supported by previous research that the application of the AIR learning is complete on student learning outcomes (Gani, Mirda, & Ismayani, 2020). Because the auditory, intellectually, and repetition learning supports students to be more enthusiastic and active in participating in learning activities, this is because the AIR learning has three stages that must be carried out by students, namely auditory (listening), intelectually (thinking), and repetition (evaluation) (Sutiyani, Sukaesih, & Mustikaningtyas, 2017). This statement is supported by research results which show that auditory, intellectually, and repetition learning has a greater effect on increasing students' numerical skills (Syazali, Iqoh, Mufty, & Rahmawati, 2021).

The results of the final test of students' mathematical communication ability in the experimental class were 28 students who completed from 30 students. Based on the calculation obtained the value of zvalue=2.32 and ttable=1.64. Because of zvalue >ztable, the means acceptance of H1. This shows that more than 75% of students in the experimental class who received AIR learning with the RME approach achieved classical mastery. Classical completeness of students is displayed in Figure 2.

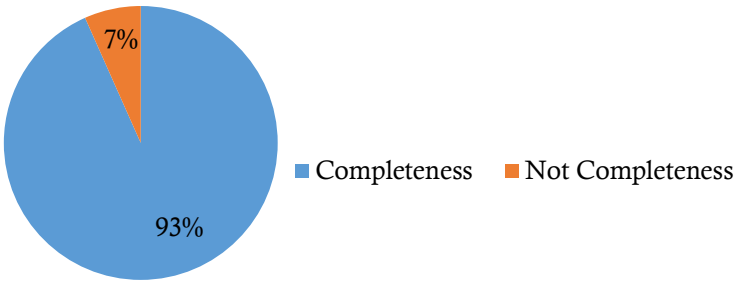

Figure 2. The Classical Completeness of the Communication Mathematis Ability.

The findings of this study are in line with the results of previous studies showing that using AIR learning can improve students' mathematical communication (Rohayati, 2018). Students who receive learning using a realistic mathematics education approach have a higher class average, this is because the teacher is able to facilitate students in thinking and discussing and the teacher motivates students to express their ideas and solve problems (Fauzi, Waluya, & Masrukan, 2018).

Several studies also show that the realistic mathematics education approach is effective on students' mathematical communication ability, this is evidenced that the average mathematical communication of students reaches the criteria of completeness (Ruswanto, Dwijanto, & Widowati, 2018). Applying a realistic mathematics education approach can improve students' understanding of mathematical concepts, this is because with the application of the approach students are more active in asking questions, discussing with friends (Febriani, Dwi, & Syahril, 2020). A realistic to mathematics education approach can also affect students' problem solving abilities for the better (Kosim, Sunardi, & Tirta, 2020). Because learning that uses a realistic mathematical education approach, students are more familiar with contextual questions, so that in solving problems students

must have a good understanding of mathematical concepts (Riyanto, Zulkardi, Putri, & Darmawijoyo, 2017). In line with the statement that the application of a realisticmathematics education approach can to improve student learning achievement, because through a realistic mathematical education approach students actively participate in learning activities (Widada et al., 2020). The use of a realistic mathematical education (RME) approach in learning can improve student achievement (Zakaria & Syamaun, 2017).

Based on the results of the analysis obtained the value of tvalue=5.7 with ttable=1.7. Because tvalue>ttable, means acceptance of H_1. So, the average value of mathematical communication ability of students who received the AIR learning with the RME approach was more than the average value of mathematical communication ability of students who received PBL learning.

This finding is supported by previous research that the auditory, intellectually and repetition learning can improve mathematics learning outcomes to be better than conventional learning (Gustriyana & Amelia, 2017). Learning that uses the auditory, intellectually and repetition learning will give good results on students' problem solving abilities (Agustiana, Putra, & Farida, 2018). Through the use of the auditory, intellectually and repetition learning, students will have better learning achievements than conventional learning models (Choirudin, Anwar, & Zulfa, 2019).

Several other studies have shown that the implementation of mathematics learning using a realistic mathematics education approach can improve students' mathematical communication ability (Trisnawati, Pratiwi, & Waziana, 2018). This is supported by research which explains that learning using a realistic mathematics education approach is complete and can have an effect on increasing students' abilities in learning mathematics (Muhtarom, Nizaruddin, Nursyahidah, & Happy, 2019). The realistic mathematics education approach emphasizes students to play an active role in groups and solve problems with study groups so that learning becomes meaningful and student-focused (Parida, Winarsih, Maksum, & Adiansha, 2018).

Previous research has shown that after applying the realistic approach to mathematics education, there was an increase in students' mathematical communication ability (Syukri, Marzal, & Muhaimin, 2020). This statement is supported by the findings of previous research that applying a realistic mathematics education approach can to improve students' mathematical communication ability (Parida et al., 2018). A realistic mathematics education approach allows students to learn more meaningfully based on contextual problems, so that students are more focused on developing their own concepts in solving problems (Laurens, Batlolona, Batlolona, & Leasa, 2018). Through a realistic mathematical education approach, students can solve problems using their own formal language in an effort to find solutions to a problem (Arnellis, Fauzan, Arnawa, & Yerizon, 2020). Realistic mathematical education approach is mathematics that is associated with the context of the reality of everyday life. The reality in question is the real situation experienced by students (Lestari & Surya, 2017). Other research shows that learning that applies a realistic mathematical education approach can improve problem solving abilities (Yuanita, Zulnaidi, & Zakaria, 2018).

To see the proportion of completeness of mathematical communication ability in the experimental class and control class, the proportion test can be used. Based on the results of the analysis obtained the value of zvalue=3.9 and ttable=1.64, because 3.9>1.64, means acceptance of H1. So, the proportion of completeness of students in the class that received AIR learning with the RME approach was better than the proportion of completeness in the class that received PBL learning. Comparison of the proportion of students' complete mathematical communication ability between the experimental class and the control class is shown in Figure 3 .

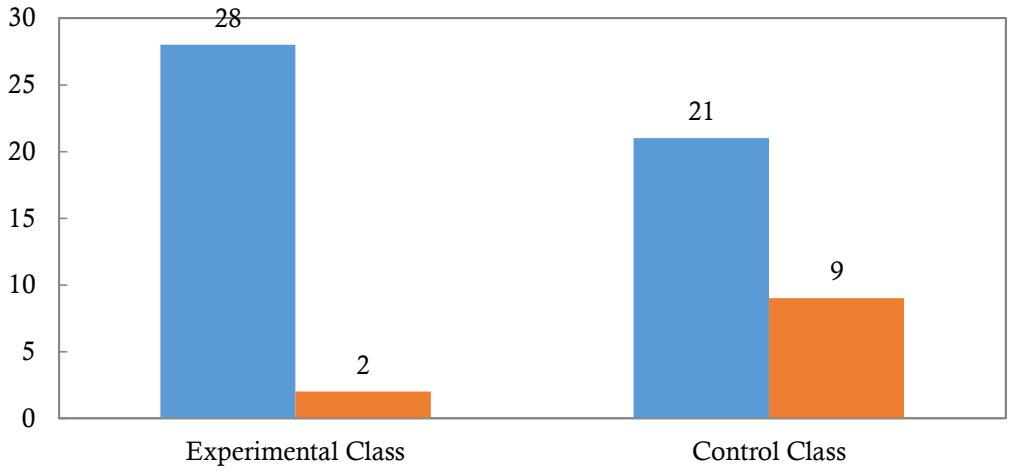

Figure 3. Completeness of the Experimental Class and Control Class Kelas.

The following will show the categories of students who have high, medium, and low mathematical communication ability on six subjects. It is presented in Figure 4.

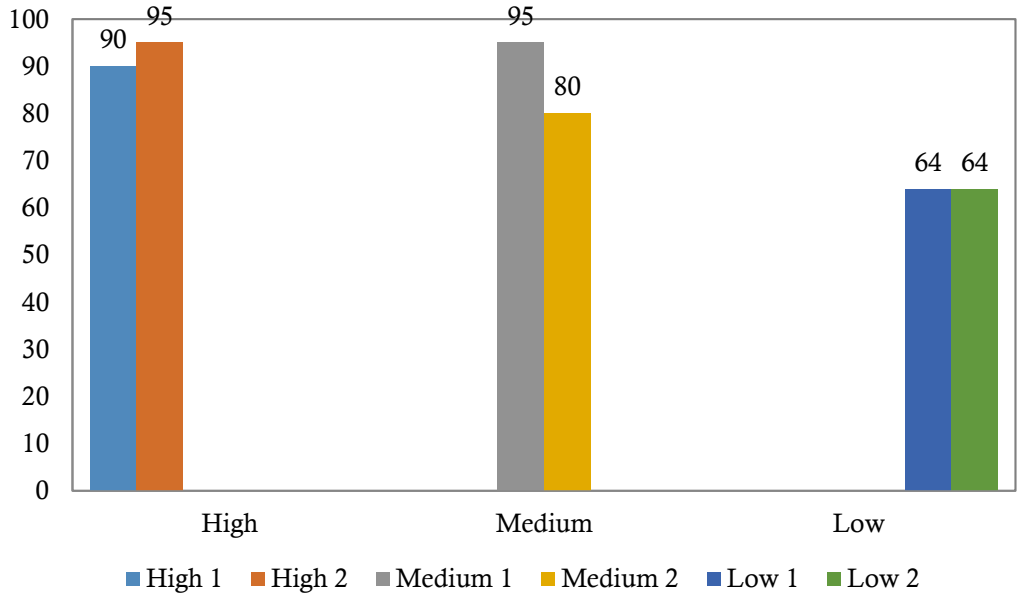

Figure 4. Catgeory of Mathematis Communication Ability.

High Category Mathematics Communication Ability.

Figure 5 is one of the students' answers in the category of high mathematical communication ability after being taught using AIR learning with the RME approach.

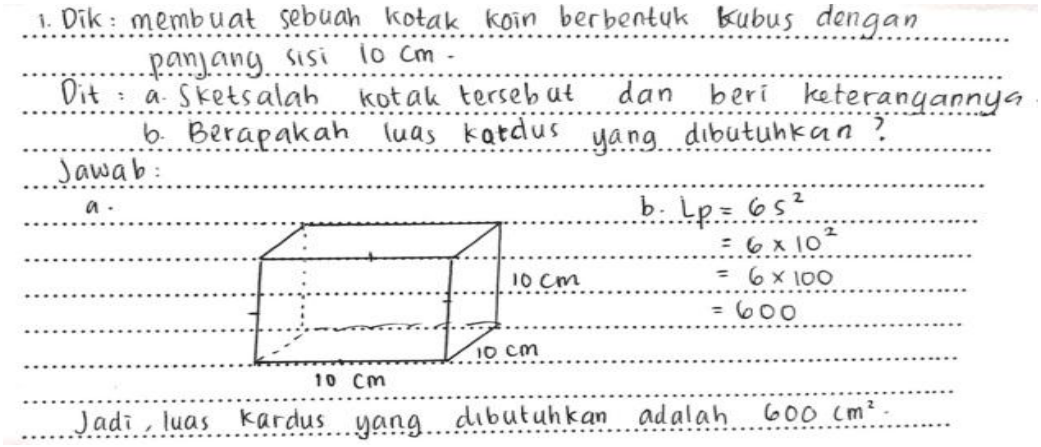

Figure 5. High Mathematical Communication Ability.

Based on Figure 5 it is informed that the indicator of the ability to connect real objects, pictures, and diagrams into mathematical ideas, students have been able to present information in the form of sketches of cube images and answer them systematically. Indicators use terms, mathematical notations and their structures students can write such as area and length and are able to write down units of area correctly such as cm3. Ability to explain ideas, situations, and mathematical relationships in writing with real objects, pictures, graphs, and algebra students can represent contextual problems by drawing cubes correctly. On the ability to state and evaluate everyday events in mathematical language and symbols, students are able to solve the surface area of a cube with the formula LP= 6s2 and explain terms in everyday life such as length and area. Then on the indicator of the ability to communicate answers to problems in the form of conclusions. Based on Figure 5 that students can communicate answers by concluding the answers correctly.

Medium Category Mathematics Communication Ability.

Figure 6 is one of the students' answers in the category of medium mathematical communication ability after being taught using AIR learning with the RME approach.

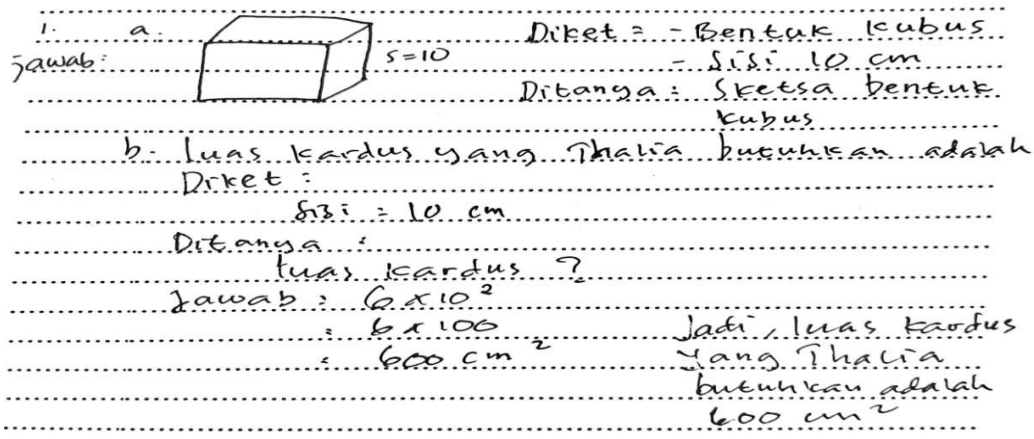

Figure 6. Medium Mathematical Communication Ability.

Based on Figure 6, the indicator of the ability to connect real objects, pictures, and diagrams into mathematical ideas, students are quite able to draw graphs and write formulas quite well. The indicator uses terms, mathematical notations and their structures

students are quite able to draw a cube and apply mathematical notation quite correctly. Indicators of ability to explain ideas, situations, and mathematical relationships in writing with real objects, pictures, graphs, and algebra students are quite able to draw cubes and perform operations quite well. Based on Figure 6, the indicator of the ability to express and evaluate everyday events in mathematical language or symbols, students are quite capable of solving and writing mathematical symbols. Based on Figure 6 that the indicator of the ability to communicate answers to problems in the form of conclusions, students are quite able to explain the steps of completion and conclude correctly.

Low Category Mathematics Communication Ability.

Figure 7 is the result of one answer after being taught using AIR learning with the RME approach.

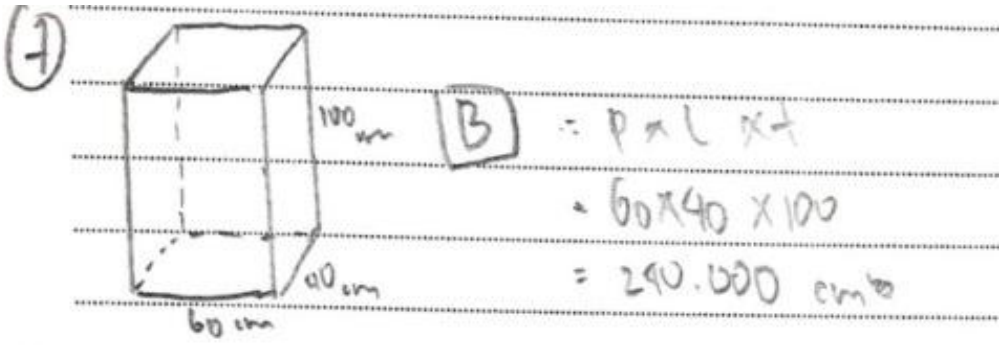

Figure 7. Low Mathematical Communication Ability.

Based on Figure 7, the indicators of the ability to use terms, mathematical notations and their structures are quite capable of using mathematical notations such as writing formulas It can be informed that the indicator of the ability to explain ideas, situations, and mathematical relationships in writing with real objects, pictures, graphs, and algebra, students are quite able to draw and perform operations correctly. Indicators of ability to state and evaluate everyday events in mathematical language or symbols. Based on Figure 7 those students have been quite able to write down the completion steps well.

Several previous studies showed that students' mathematical communication was better after using the auditory, intellectually and repetition learning (Purwanto, Jusmalisa, Sari, Jatmiko, & Pasetiyo, 2020). The mathematical abilities of students who use realistic mathematical education have higher abilities than students who study using conventional approaches (Febriyanti, Bagaskorowati, & Makmuri, 2019). The results of other studies also show that students' mathematical communication ability are higher than students who receive conventional learning (Anggraini & Fauzan, 2018).

Mathematics learning that uses a realistic mathematics education approach can improve students' mathematical communication ability (Paroqi, Mursalin, & Marhami, 2020). In addition, applying auditory, intellectual and repetition learning can improve students' mathematical reasoning and communication ability (Palinussa, Molle, & Gaspersz, 2021).

Several studies also found that students' mathematical problem solving skills increased after being taught using the auditory, intellectually and repetition learning with a very good category (Simamora, 2019). Using auditory learning intellectually and repetition can improve student learning outcomes (Manurung & Sagita, 2019). Based on the results of previous studies that the auditory, intellectually and repetition learning with a realistic mathematics education

approach can improve students' communication ability (Rizqi, Waluya, & Wiyanto, 2021).

Several other studies have shown that there is an increase in students' mathematics learning outcomes that are better after being taught using the auditory, intellectually and repetition learning (Sopia, 2019). This finding is also in line with previous research that the average mathematical communication ability of students using the auditory, intellectually and repetition learning is higher than the mathematical communication ability of students who receive conventional learning (Ulva & Suri, 2019).

The same finding in previous research shows that there are significant differences in problem solving abilities between students in the experimental class using the auditory, intellectually and repetition learning, where students' mathematical problem solving in the experimental class is included in the high category (Kamsurya & Saputri, 2020). It is because the auditory learning model intellectually and repetition encourages students to be more active in the process of learning activities, it has an impact on increasing students' conceptual understanding skills (Hermawati, Pebriyanti, & Fitriyani, 2020).

Several studies have shown that the realistic mathematics education approach can improve students' mathematical communication ability by increasing the good category (Kuswantoro & Taram, 2020). The same finding also shows that there is an increase in the mathematical communication skills of students who receive learning using a realistic mathematical education approach better than students who receive conventional learning (Juliati, Firman, & Nugraha, 2018). Because the RME approach can facilitate students to be more active in interacting between students and students, and teachers and students (Marpaung, Minarni, & Panjaitan, 2020).

Findings in other studies also show an increase in students' mathematical communication ability using a realistic mathematical education approach (Jasija, Fitriana, & Aripin, 2018). In addition, through learning that uses a realistic mathematics education approach, it can affect students' mathematical reasoning and mathematical communication ability, this is because students are more active in communicating to solve mathematical problems when compared to students who study with conventional learning where learning is only teacher-centered (Palinussa et al., 2021). The application of learning facilitated by a realistic mathematical education approach can have a positive effect on students' mathematical communication ability because the RME approach begins learning mathematics with real problems related to students' daily lives and uses problem solving built by students through teacher guidance (Marpaung et al., 2020).

CONCLUSION

Based on the results of research and discussion, it was concluded that the average mathematical communication ability of students in the experimental class who received AIR learning with the RME approach reached the actual completion limit, the proportion of students in the experimental class achieved the actual completion limit value had reached more than 75%, the average value of students' mathematical communication ability in AIR learning with the RME approach is better than the average value of students' mathematical communication ability in the control class, the proportion of completeness of students' mathematical communication skills in classes taught with AIR learning with the RME approach is better than the proportion of completeness students' mathematical communication ability in classes taught with PBL learning. Students who have high mathematical communication skills are able to present sketches, use mathematical notation, then complete and conclude correctly. Students who have moderate mathematical communication skills are quite capable of sketching pictures, applying mathematical notation. Then students who have low mathematical communication skills are quite capable of sketching pictures, writing mathematical notation.

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