UJMER (2) (2022) 220-231

Unnes Journal of Mathematics Education Research

http://journal.unnes.ac.id/sju/index.php/ujmer

Students' Mathematical Communication Skills based on AQ in Discovery Learning Model with Realistic Approach

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Article Info

Article History:
Received 15 September 2019
Accepted 05 January 2021
Published 23 December 2022

Keywords:
Adversity Quotient (AQ),
Discovery Learning,
Mathematical Communication Ability,
Realistic Approach

Abstract

Mathematical communication skills are important for students in understanding and conveying mathematical ideas, while the Adversity Quotient (AQ) determines how well students face difficulties in learning mathematics. The purpose of this study is to determine the patterns of mathematical communication skills in terms of the students' AQ categories. This research applied mixed methods with concurrent embedded design. Data collection was carried out through questionnaires, observations, tests, interviews, and documentation. The quantitative research used the randomized pretest-postest control group design. The selection of research subjects used purposive sampling technique. Testing of quantitative data used z-test and t-test. The qualitative data were analyzed descriptively. The results showed: the learning quality of the Discovery Learning model with realistic approach at the planning and implementation stages was good, while the evaluation stage did not meet the criteria; AQ has a positive influence on students' mathematical communication skills; The climbers students showed good achievement on the indicators 1-3, while the indicator 4 showed quite good achievement, the campers students showed fairly good achievement on the indicators 1-4, the quitters students showed poor achievement on the indicators 1-4. The higher the AQ of students, the higher their mathematical communication skills tend to be. Therefore, the teacher's attention in responding to students' AQ wisely can improve their mathematical communication skills.

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p-ISSN 2252-6455
e-ISSN 2502-4507

INTRODUCTION

Mathematics is often said to be a human activity, since almost all aspects of human life involve mathematics. Through mathematics, a science can develop rapidly more than humans expect (Wardani, 2010). Considering the important role of mathematics, mathematics learning is given at every level of education in Indonesia.

Mathematical skill standards according to NCTM (2000) that must be achieved by students, namely: (1) problem solving; (2) mathematical communication; (3) mathematical connection; (4) mathematical reasoning; and (5) mathematical representation. In line with NCTM, the Kemendikbud (2014) mentions 1 of the 9 principles of the intracurricular learning process in the 2013 curriculum, namely observing (seeing, reading, listening), asking (verbal, written), analyzing (connecting, determining linkages, building stories/concepts), communicating (verbal, written, pictures, graphs, tables, diagrams, etc.). In summary, Marliani, Waluya, & Cahyono (2019) stated that learning in the 2013 curriculum increases creativity through 6M activities (observing, asking, trying, reasoning, creating, and communicating). Based on this description, one of the mathematical skills that are expected to emerge after learning mathematics includes communicating ideas with symbols, tables, diagrams, or other media to clarify the situation or problem. These components are the substance of mathematical communication skills.

Mathematical communication skills are the ability to convey mathematical ideas, both verbally and in writing as well as the ability to understand and accept other people's mathematical ideas carefully, analytically, critically, and evaluatively to sharpen understanding (Lestari & Yudhanegara, 2015). Indicators of communication skills according to Fatimah (2012) include: (1) presenting mathematical statements verbally, in writing, pictures and diagrams; (2) submitting allegations; (3) performing mathematical manipulation; and (4) drawing conclusions, compiling evidences, providing reasons or evidences of the correctness of the solution. Indicators of mathematical communication skills according to Zakiri, Pujiastuti, & Asih (2018) include: (1) showing steps in problem solving, (2) expressing strategic ideas in problem solving; (3) expressing ideas in the form of pictures, tables or graphs; (4) writing conclusions in solving problems in accordance with mathematical concepts; and (5) writing down mathematical terms and symbols in expressing ideas. Providing good mathematical communication skills, students find it easier to understand, determine strategies, and solve the math problems they face. This is in line with Permata, Kartono, & Sunarmi (2015) statement that without mathematical communication skills, students will not be able to convey their mathematical ideas to others. Sefiany, Masrukan, & Zaenuri (2016) also revealed that mathematical communication skills are needed by students in conveying mathematical ideas both verbally and in writing. The important roles of mathematical communication skills in mathematics learning according to Asikin & Junaidi (2013) include: (1) tools to exploit mathematical ideas and help students to see various relationships of mathematical materials, (2) tools to measure the growth of understanding and reflect on students' understanding of mathematics, (3) tools for organizing and consolidating students' mathematical thinking, and (4) tools for constructing mathematical knowledge, improving reasoning, fostering self-confidence, and increasing social skills.

Students' mathematical communication skills in Indonesia are below expectation. This is shown by the summary of the PISA results in 2018 by the OECD (2019), Indonesia achieved a score of 379 in mathematics from the average score of 489. This score shows a decreasing compared to the previous PISA score in 2015. This data shows that the junior high school students' mathematical skills in Indonesia needs to be improved in the aspects of problem analysis, reasoning, and mathematical communication. The low mathematical communication skills of junior high school students were also found in the 8th grade of SMP Negeri 2 Brebes during their preliminary study. The results of the initial test of mathematical communication skills to students in 5 classes showed that the percentage of completeness of each class had not reached 25% yet. This is because students do not understand the problems well, do not know to write mathematical ideas or illustrate it into pictures appropriately, unable to use mathematical symbols appropriately, and unable to come up with ideas to solve these problems.

The low achievement of students' mathematical skills results in mathematics being

considered as a difficult subject. Many students meet difficulty in learning and solving math problems. However, there are students who are able to pass the difficulties in learning mathematics as well. This is because scientifically the students have difference abilities and characteristics in dealing with problems. Stoltz (in Shivaranjani, 2014) introduced a concept of fighting power called Adversity Quotient (AQ), which describes a person's level of ability to overcome difficulties. Stoltz (2000) classifies a person's AQ into 3 categories, namely climbers (a group of people who persist in facing various problems), campers (a group of people who already have the will to try to face the problem, but give up because they feel they are no longer able to face it), and quitters (a group of people who are less willing to accept the challenges). To overcome the low mathematical communication skills of students of SMP Negeri 2 Brebes, especially on geometry, the AQ aspects of students need to get attention from the teacher.

One of the studies that raises the topic of mathematical communication skills with one type of human intelligence is research by Pangastuti, Johan, & Kurniasari (2014), which analyzing the profile of junior high school students' mathematical communication skills in terms of Emotional Quotient (EQ). Unlike other types of intelligence (IQ, EQ, and SQ) that are already popular, knowledge of AQ in research school is not familiar. This was shown when some teachers at SMP Negeri 2 Brebes asked about AQ. Therefore, researchers assume that no or very few studies in that school have examined AQ.

One of the efforts that the teacher can do is to develop innovative learning devices with a learning model that can provide a stimulus to students in order to improve their mathematical communication skills. Savelsbergh, et al (2016) stated that innovative learning is divided into 5 types, namely discovery/inquiry-based, context-based, computer-based, collaborative learning, and extra-curricular activities. In addition to determining the right learning model, teachers also need to pay attention to the learning approach used. One of the lessons in accordance with these recommendations is the Discovery Learning model with realistic approach. Discovery Learning according to Mawaddah, Kartono, & Suyitno (2015) is a learning in which students build their own knowledge by experimenting and making conclusions about rules/concepts from the experiment. Fathurrohman (2015) states that learning by discovery involves communication which means that there is space, opportunity, and energy for students to ask questions and logical views, objective, and meaningful. Learning by discovery is also useful for communicating students' work results.

Human activity will never be separated from the real world. Izzati & Suryadi (2010) view that mathematics must be related to reality, it means that mathematics must be close and relevant to students' life. In learning mathematics, the benefits of learning mathematical concepts will be felt when learning is linked to real life. Therefore, Discovery Learning should bring real problems. The approach that fits the situation is the realistic approach. In applying the realistic approach, students are not immediately presented with abstract mathematical concepts, but are first introduced through real phenomena which are transformed into abstract concepts. Activities of changing real-world situations into mathematical models like this are what give students the opportunity to practice their mathematical communication skills.

Based on the previous description, researchers conducted a research at SMP Negeri 2 Brebes with the aims of: (1) knowing the learning quality of the Discovery Learning model with realistic approach in order to improve students' mathematical communication skills, (2) knowing the effect of AQ on mathematical communication skills, (3) knowing The pattern of mathematical communication skills of students at SMP Negeri 2 Brebes in terms of AQ in the implementation of the Discovery Learning model with realistic approach.

METHODS

This research type is mixed-methods. This research strategy used the concurrent embedded design method, which was an unbalanced mixture. The quantitative research design used the randomized pretest-posttest control group design, so it requires 2 sample classes (experimental class and control class). The research was conducted at SMP Negeri 2 Brebes with 8th grade material in the even semester in the academic year of 2017/2018, namely the surface area of a flat side three-dimentional figures.

The research procedure was divided into 2 stages: (1) the pre-field stage (compiling the research design, selecting the research site, taking care of permits, preliminary observation, preparing research

equipment, validating learning devices and research instruments by expert validators), and (2) the fieldwork stage (initial test and final test trials, initial test implementation, enforcement of the Adversity Response Profile (ARP) questionnaire to determine students' AQ scores, implementation of the Discovery Learning model with realistic approach, conducting final test, and conducting interviews).

The population in this study were students of the 8th grade of E – the 8th grade of I. Determination of the sample class usied the cluster random sampling technique, so that the 8th grade of H was selected as the experimental class which was applied to the Discovery Learning model with realistic approach, and the 8th grade of E as the control class applied to the PjBL model with scientific approach. This study required 6 research subjects taken from 2 climbers students, 2 campers students, and 2 quitters students. Determination of research subjects used purposive sampling technique.

Quantitative data collection techniques used test methods in the form of initial test and final test of mathematical communication skills given to the sample classes. While the qualitative data collection techniques used questionnaires (ARP and student responses), observations (observation of teacher performance and observation of student activity as secondary data), interviews, and documentations (test results and photos of research activities).

The learning quality of the Discovery Learning model with realistic approach was analyzed qualitatively and quantitatively. The assessment of the learning quality qualitatively was seen from the results of: validation of learning devices and research instruments, observation of learning implementation, observation of students activity, and students responses to learning. The assessment of the learning quality quantitatively includes the proportion test (z-test) and the average difference test (one sample t-test and independent samples t-test) on the final test data of the experimental class and control class students.

To determine the effect of AQ on mathematical communication skills, AQ score data (as the independent variable) and final test result data (as the dependent variable) are needed. This test was carried out in three stages, namely the classical assumption test (normality and homogeneity test), linearity test using a linear model with the equation of $\hat{y} = a + bx$ (to determine whether there is a relationship or influence of the independent variable on the dependent variable), and simple linear regression test (a continuation of the linearity test, to find out how much the effect is and to find out the estimating equation).

The pattern of students' mathematical communication skills based on AQ was analyzed descriptively based on the documents of test results and interviews with 6 research subjects. The stages of qualitative data analysis adopted from Miles & Huberman in Sugiyono (2013), namely data reduction, data presentation, and making conclusions.

RESULT AND DISCUSSION

The learning quality is assessed from 3 stages. The first stage is planning (preparing learning devices that will be validated by experts validators), the second stage is implementation (observation of learning implementation, students activity, and student responses), and the third stage is evaluation. The results of the validation of learning devices can be seen in Table 1.

Table 1. Learning Devices Validation Results

Learning Devices	Average	Validity	Category
Syllabus	3.96	Valid	Good
Lesson Plan	4.21	Valid	Very Good
Student Worksheet	4.30	Valid	Very Good
Teaching Materials	4.46	Valid	Very Good
Initial Test	4.38	Valid	Very Good
Final Test	4.50	Valid	Very Good

Based on Table 1, it can be concluded that the learning devices in this study are valid (al least categorized as good), so that the learning devices are feasible to use.

The observation result of the implementation of learning are presented in Table 2.

Table 2. Observation Results of Learning Implementation

Meetings	Average	Percentage	Category
1	4.54	90.77	Very Good
2	4.62	92.31	Very Good
3	4.31	86.15	Very Good
4	4.15	83.08	Good
Total Average	4.40	88.08	Very Good

From Table 2 above, it can be seen that the total mean score of learning implementation during 4 meetings obtained a value of 4.40 which is categorized as very good. In general, it can be concluded that learning with the Discovery Learning model with realistic approach is well-implemented.

Observation of student activity is limited to 6 research subjects only. Observations were conducted during 4 meetings. The results of student activeness observations are presented in the Table 3.

Table 3. The Observation Results of Student Activeness

Research Subjects	Average Percentage of Activity	Category
S-1	97.57	Very Good
S-2	95.14	Very Good
S-3	83.33	Good
S-4	86.46	Very Good
S-5	54.52	Poor
S-6	50.00	Poor
Total Average	77.84	Good

Observation of activeness in this study refers to the aspects of writing activities, listening activities, speaking activities, and motor activities. The results of the observation of student activeness in Table 3 show a total mean of 77.84% which is categorized as good. In general, it can be concluded that students are actively involved in participating in the Discovery Learning model with realistic approach. Other informations obtained from Table 3, namely climbers students (S-1 and S-2) showed very good involvement in learning, campers students (S-3 and S-4) showed varied involvement in learning, while climbers students (S-5 and S-6) show poor involvement in learning.

Students response questionnaires were given to 36 students in the experimental class after learning for 4 meetings was completed. The results of the students response questionnaire are presented in Table 4.

Table 4. Student Response Questionnaire Results

Percentage	Category	Frequency
$20 \leq P < 36$	Worst	0
$36 \leq P < 52$	Poor	0
$52 \leq P < 68$	Fairly Good	4
$68 \leq P < 84$	Good	15
$84 \leq P \leq 100$	Very Good	17

Based on the data processing of the results of students response, the average percentage of students response was 81.36% at the interval 68% ≤ P < 84% which is categorized as good. So, it can be concluded that students who are given the Discovery Learning model with realistic approach show a good/positive response, exceeding the specified percentage limit of 70%.

At the evaluation stage, 4 kinds of hypothesis testing were carried out, namely the proportion completeness test, the proportion difference test, the average completeness test, and the average difference test. In the four tests, the significance level used is 5%.

The proportion completeness test was carried out by comparing the proportion of students in the experimental class who completed the final mathematical communication skills test with the specified classical completeness percentage, namely 75%. The test was carried out using the left party proportion test. The test criterion is to reject H_0 if $z \geq z_{table}$ $(0.5 - \alpha)$. Based on the calculation results, it is obtained that $z = -0.387 < z_{table}(0.45) = 0.174$. This means that H_0 is accepted, so it is concluded that the proportion of students who have applied the Discovery Learning model with realistic approach has not reached 75% yet.

Proportion difference test was carried out by comparing the proportion of completeness of the final test in the experimental class and the control class. The test used the left party proportion difference test. The test criterion is to accept H_0 if $z < z_{table}(0.5 - \alpha)$. Based on the calculation results, it is obtained that $z = 2.390 > z_{table}(0.45) = 0.1736$. This means that H_0 is rejected, so it is concluded that the proportion of completeness of the final test of communication skills

of students who are applied to Discovery Learning with realistic approach is more than the proportion of completeness of students who are applied to PjBL learning with scientific approach.

The average completeness test was carried out by comparing the average final test results in the experimental class with the KKM value set at 72.30. The test used the left party Student's t-test. The test criterion is reject H_0 if $t \geq t_{table}$. Based on the calculation results, obtained $t = 2.064 > t_{table} = 0.063$. This means that H_0 is rejected, so it is concluded that the average final test result of students' mathematical communication skills applied learning Discovery Learning with realistic approach reaches KKM.

The average difference test was carried out by comparing the average of the final test results of the experimental class and the control class. The test used independent samples t-test on the left party. The test criterion is to reject H_0 if $t \geq t_{table}(1 - \alpha)$, where $dk = (n_1 + n_2 - 2) = 36 + 36 - 2 = 70$). Based on the calculation results, obtained $t = 2.115 > t_{table}(0.95) = 0.063$. This means that H_0 is rejected, so it is concluded that the average of the final test result of students' mathematical communication skills applied learning Discovery Learning with realistic approach is more than the average of the final test results of students who are applied PjBL learning with scientific approach.

Based on the results of testing 4 hypotheses at the evaluation stage, only 3 hypotheses met the criteria for the effectiveness of learning. The test that did not meet the criteria is a proportion completeness test. So, at the evaluation stage it is concluded that the Discovery Learning model with realistic approach did not meet the criteria for effective learning. This finding is not in line with the results of research by Dina, Mawarsari, & Suprapto (2015) which stated that the implementation of the Discovery Learning model on geometric material is effective for students' mathematical communication skills.

The learning quality is the success of the learning activities carried out (Zahroh, 2015). The learning quality has good criteria if the results of the assessment are at 3 stages: (1) The planning stage, the learning devices that have been compiled are valid; (2) the implementation stage, the implementation of learning and the activeness of students at least categorized as good, getting a positive response from students (more than 70%); and (3) the evaluation stage, fulfilling the 4 requirements for the effectiveness of learning. Based on the results of the assessment of the learning quality of the Discovery Learning model with realistic approach, the planning and implementation stages have met good standards. Meanwhile, the evaluation stage has not met the criteria for effective learning. However, if you look at the results of the proportions different test and the average difference test, the good information found is that the Discovery Learning model with realistic approach gives better output than the PjBL model with scientific approach in terms of developing students' mathematical communication skills. Empirically, this is indicated by the proportion of completeness and the average result of the final test of learning with the Discovery Learning model with realistic approach respectively 72.22% and 75.56, while for learning the PjBL model with scientific approach respectively 44.44% and 70.93.

Similar to teamwork, good learning will be achieved if the roles of teachers and students show good performance in accordance with their respective assignments. However, if one or both of them tend not to perform well, then the learning tends not to be of good quality.

Next is the discussion about the influence of AQ on students' communication skills. Students' AQ scores were obtained by completing the Adversity Response Profile (ARP) questionnaire. ARP is only given to students in the experimental class. The data needed to answer this problem is the AQ score data of the experimental class students (as the independent variable) and the final test result data of the experimental class students' mathematical communication skills (as the dependent variable). The results of the ARP questionnaire validation by expert validator are presented in Table 5.

Table 5. ARP Questionnaire Validation Results

Assessment Score on Aspect-						Average	Category
I	II	III	IV	V	VI		
5	4	4	3	3	3	3.67	Good

Based on Table 5, the mean score of the assessment by the validator is 3.67 which is categorized as good. That is, the ARP that has been compiled is feasible to be used to retrieve AQ data from students in the experimental class. The results of students category based on AQ level can be seen in the following Table 6.

Table 6. Students Category Results Based on AQ

AQ Category	Frequency
Climbers	12
Campers	21
Quitters	3

The results of the students' AQ categories in Table 6 are in accordance with Stoltz's (2000) statement that AQ collects more often in the middle than at both ends of the series in a normal distribution based on norms of more than 75,000 respondents.

Before carrying out a simple linear regression test, a prerequisite test/classical assumption test is carried out first to test whether the independent and dependent variables are feasible or not to be carried out a regression test. The purpose of the classical assumption test is to provide certainty that the regression equation obtained has accuracy in estimation, unbiased, and consistent (Sukestiyarno, 2015). If the classical assumption test is fulfilled, then the test is continued to the linear regression test stage. Classical assumption tests that are carried out include the normality test, homogeneity test, and linearity test.

The normality test was carried out used the SPSS program used the Kolmogorov-Smirnov test. The data that was tested for normality were the dependent variable data. The hypothesis formulation is H0 that means the dependent variable data is normally distributed, H1 means the dependent variable data is not normally distributed. The test criterion is to accept H0 if Sig > 5%. Based on the output of the K-S normality test with SPSS, it was obtained Sig = 0.128 = 12.8% > 5%. This means that H0 is accepted, so that the dependent variable data is normally distributed.

The homogeneity test can be carried out simultaneously with the normality test with SPSS, because the normality test can be seen in the same output as the K-S normality test, namely the dependent variable descriptive statistical test output table. Based on the output of the descriptive statistical test table for the dependent variable, the Skewness value obtained is -0.657. According to Sukestiyarno (2015), the negative sign on the Skewness value which is close enough to the zero value can be interpreted that the data distribution tends to form a normal curve even though it is not so perfect. While the Kurtosis value obtained is 0.881 which is a positive value and means that the Q-Q Plot diagram tends to be clustered. Data that are clustered or tend to be close to the line of probability means that the dependent variable data tends to be homogeneous. For more details, the Q-Q diagram of the dependent variable data plot can be seen in Figure 1.

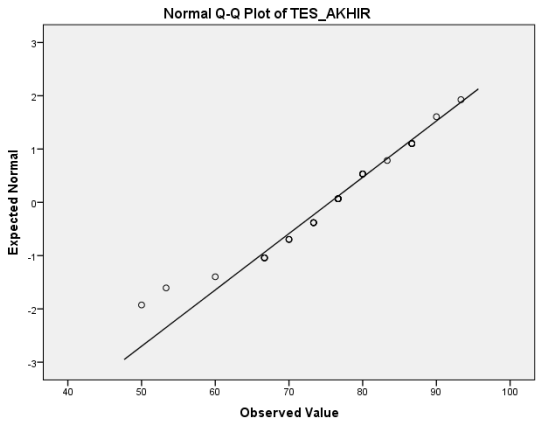

Figure 1. Q-Q Plot Diagram of Dependent Variable Data

Based on Figure 1, it is clear that the data is clustered following the opportunity line and there are 2 outlier data that are slightly away from the opportunity line. Because the majority of the data approaches the line of opportunity, the dependent variable data tends to be homogeneous. Based on this description, the dependent variable data has met the assumptions of normality and homogeneity.

After the normality and homogenity tests are fulfilled, it continues to the linearity test. Linearity test was performed using SPSS with the linear equation $\hat{y} = a + bx$. This test aims to determine whether there is a linear relationship or not between the independent and dependent variables that forms a straight line, in other words the linear relationship of the independent variable affects the dependent variable. The hypothetical form of the linear model is H0, which means the equation model is not linear/there is no relation, and H1 which means the equation model is linear/there is a relationship. The test criterion is to accept H0 if Sig > 5%. Based on the ANOVAa output, the Sig = 0.00 = 0.00% < 5% was obtained. This means that H0 is rejected, so it can be concluded that the equation model is linear/there is a relationship between students' AQ scores and the final test results of their mathematical communication skills.

If the dependent variable and the independent variable are said to have a linear relationship, it means that the independent variable has an effect on the dependent variable (Sukestiyarno, 2015). The form of the regression estimator equation and how much the AQ score has an influence on students' mathematical communication skills can be seen in the coefficients output on the linear regression test with SPSS. Based on this output, the constant value of a = 35.453 and the coefficient value of the AQ variable is b = 0.327, so that the estimator form of the linear regression model equation is $\hat{y} = 35{,}453 + 0{,}327x$. At the output of the Model Summary linear regression test, the value of R square = 0.755 = 75.5%. This value means that the variable results of the final test of mathematical communication skills can be explained/influenced by the AQ score variable of 75.5%, and there are 24.5% of the variable mathematical communication skills test results which are influenced by other variables besides the AQ score.

The ARP questionnaire that has been used to measure AQ scores is valid with good ratings, so that the accuracy of students' AQ scores should be good and unbiased. The distribution of AQ data tends to be centered or in the campers category, so this phenomenon is in accordance with Stoltz's opinion. Linear model regression testing has met the test requirements on the dependent variable data. Linearity test results are also accepted by the estimator model in the form of linear equations. It can be said that the AQ score has a positive effect on the test results of mathematical communication skills, but it does not necessarily apply otherwise. This finding is in line with Suhendri's (2018) research that there is an effect of resilience (Adversity Intelligence) on students' mathematical abilities, where in this study, communication is also one of mathematical ability. The accepted estimation equation for linear regression is $\hat{y} = 35{,}453 + 0{,}327x$, for x is an independent variable, which means that 1 point AQ score contributes to the final test score of mathematical communication skills by 0.327 points with a fixed value of 35.453.

Based on these findings, students' AQ plays a role in mathematics learning and affects students' mathematical communication skills. Therefore, teachers need to pay attention to students' AQ and make efforts to improve students' AQ in order to improve their mathematical communication skills.

The next discussion is about the pattern of students' mathematical communication skills in terms of the AQ category. Mathematical communication skills in this study are the skills of the students to convey mathematical ideas both in writing (descriptions, pictures, diagrams, tables, mathematical symbols, or algebraic forms) or verbal (verbal directly or using media) to clarify the situation, and also the students' skills in understand other people's mathematical ideas (careful, analytical, critical, and evaluative) to gain a better understanding. The indicators of mathematical communication skills applied in this study include: (1) presenting mathematical statements in images, tables, graphs, diagrams, and algebraically; (2) stating everyday events in mathematical language (using terms, mathematical symbols) to present ideas and show relationships with situation models; (3) performing mathematical manipulation; and (4) drawing conclusions, compile evidence, provide reasons or evidence of the correctness of the solution.

Analysis of mathematical communication skills was carried out on 6 selected research subjects based on the results of their initial test and final test of mathematical communication skills. Qualitatively, the descriptive analysis results of the pattern of initial mathematical communication skills based on AQ are presented in Table 7.

Table 7. The Patterns of Students' Initial Mathematical Communication Skills Based on AQ

AQ Category	Indicators of Mathematical Communication Skills			
	I	II	III	IV
Climbers	Fairly Good	Poor	Poor	Fairly Good
Campers	Poor	Poor	Poor	Fairly Good
Quitters	Poor	Poor	Poor	Poor

Based on Table 7, the initial skills of students of climbers category were quite good on indicators 1 and 4, but not good at indicators 1 and 3. The students initial skills in the campers category were quite good on indicator 4, but not good at indicators 1, 2 and 3. The quitters category students' mathematical communication skills were poor on all indicators. The descriptive analysis results of the pattern of final mathematical communication skills based on AQ are presented in Table 8.

Table 8. Students' Final Mathematical Communication Skills Pattern Based on AQ

AQ Category	Indicators of Mathematical Communication Skills			
	I	II	III	IV
Climbers	Good	Good	Good	Fairly Good
Campers	Fairly Good	Fairly Good	Fairly Good	Fairly Good
Quitters	Poor	Poor	Poor	Poor

Based on Table 8, the students' final skills of climbers category were good at indicators 1, 2, and 3, but not good at indicator 4. The final skills of the campers category students were quite good on all indicators. The students' final mathematical communication skills of the quitters category were not fairly good on all indicators.

When compared between the pattern of the initial skills and the final skills of the research subjects in Table 7 and Table 8, it is found that the students in the climbers and campers categories experienced an increasing in the quality of their skills on indicators 1, 2, and 3, while for indicator 4 the skills of the two categories have not increased. The quitters category did not appear to have significantly improved all indicators of mathematical communication skills.

Based on the analysis results of the pattern of mathematical communication skills in the climbers category students, they had the best mathematical communication skills compared to the campers and quitters category students. The students' mathematical communication skills in the climbers category achieved good criteria on indicators 1-3, while in indicator 4 they only achieved fairly good criteria. Based on these findings, it can be concluded that the students in the climbers category did not always show good/high mathematical communication skills. This is in line with the research of Wicaksono, Waluya, & Asih (2019), that students with high AQ do not always have a high level of mathematical problem solving skills either.

Regarding to indicator 1, the climbers category students are fluent in pouring mathematical statements into visual form properly, complete with mathematical symbols to clarify their ideas. Based on the results of the interview, the students in the climbers category did not experience significant difficulties in solving questions containing indicator 1. Regarding to indicator 2, the climbers category students were not confused when dealing with questions containing mathematics variables. Students in the climbers category were able to show the relationship between the measurements containing the variables of a shape and its parts. Regarding to indicator 3, students in the climbers category were able to manipulate mathematically using certain methods to solve the questions. Students in the climbers category have no difficulty in determining the surface area of the shape that will be needed to calculate the surface area of the compound shape. Students in the climbers category also knew that they had to go through certain steps to achieve the final result of the questions they worked on. Regarding to indicator 4, students in the climbers category reached the fairly good category because there were differences in the level of ability between S-1 and S-2 in solving questions related to compiling evidence, drawing conclusions, providing evidence of the correctness of the solution, where in indicator 4 individually S-1 achieved a good category, while S-2 achieved a fairly good category.

Based on the analysis results of the pattern of mathematical communication skills in the campers category, their skills are in the middle. The results of the analysis showed that the campers category students achieved a fairly good category in all indicators. This is because the majority of students in the experimental class gather in this category, so it is likely that many students in this category show more diverse abilities when compared to the students in the climbers and quitters category.

Regarding to indicator 1, students in the campers category are able to present mathematical statements into pictures quite well, but are not equipped with symbols to clarify the situation. Regarding to indicator 2, based on the final test result documents, students in the campers category did not write down ideas or provide explanations to show the relationship between the measures that contain the variables in the 3-dimensional figure and the parts of the shape. However, based on the results of the interview, students in the campers category showed fairly good performance in expressing ideas and showing relationships with situation models even though they seemed to show expressions of confusion and uncertainty about their own explanations. Regarding to indicator 3, students in the campers category generally did not experience significant

difficulties. However, several times students in the campers category were found not to complete their answers with given and asked information. This is different from the students in the climbers category who tended to write their answers completely. Regarding to indicator 4, students in the campers category are the same as climbers, that is, they are fairly good at compiling evidence, drawing conclusions, providing evidence of the correctness of the solution. The difference is that the students in the climbers category always wrote the answer conclusions at the end of the completion, while the students in the campers category rarely did that. The students in the campers category when being interviewed showed hesitant expressions in delivering explanations even though the explanations were correct. This is in accordance with the opinion of Stoltz (2000), that students in the campers category do not want to take too big a risk (in this case is an error in answering the questions).

Based on the analysis results of the pattern of mathematical communication skills in the quitters category, they have the lowest mathematical communication skills compared to other categories of students. This is indicated by low involvement in learning, little effort to try to solve the problem, even the quitters category students are the most difficult to ask questions, ideas, or presentations in front of their friends.

Regarding to indicator 1, students in the quitters category have not been able to present mathematical statements in pictures properly. The quitters do not use mathematical symbols to clarify situations. The answers that the students in the quitters category wrote did not match what the questions asked for. Based on the results of the interview, when they faced difficulties, they seemed resigned and there was no burden when they said they were not good at math. Regarding to indicator 2, the quitters students have not been able to present ideas and show the relationships with situation models well. Based on the results of the interview, they did not even understand the meaning of the item which contained indicator 2. When the researcher asked them to explain the purpose of the question, they just reread the question. When quitters category students were asked to provide an explanation about the solutions they wrote, they could not explain well because they did it carelessly. Regarding indicator 3, students in the quitters category have not been able to perform mathematical manipulations using certain methods to achieve the objectives of the problems they are working on. The quitters category students have not been able to decide to use the right strategy to solve the problem, for example, they cannot determine which area is used and are not used to calculate the surface area of the compound shape. Students in the quitters category were also seen to be wrong in doing algebraic manipulation, which is about the addition of integers with irrational numbers. In some of the interview questions, the quitters category was seen to be more silent than to answer the questions. Regarding to indicator 4, students in the quitters category have not been able to compile evidence, draw conclusions, provide reasons or evidence for the correctness of the solution. Based on the written document of the final test results of mathematical communication skills, the quitters category students have not been able to conclude and provide evidence correctly about mention the name of any shape that given its measures only. Based on the results of the interview, students in the quitters category tended not to write down the summary answers at the end of the solution. They assume that when the calculation results have been obtained, the process of answering questions is complete. The active participation of quitters category students in participating in Discovery Learning with realistic approach is minimal. They tend to be passive. The observation of the quitters' activeness also showed unfavorable results. The quitters category students tend to find it difficult to be asked to work on problems, express ideas, ask questions, or present their group's findings. When they asked to move forward in front of the class to write down their own solutions, they chose to stay in their seats, even though the researcher had asked their classmates to accompany them to work on the problems in front of the class. This is in accordance with Sari's (2016) opinion which states that quitters usually feel inferior in dealing with math problems, especially because of the assumption that mathematics is a complicated subject, so students in the quitters category tend to avoid problems, for example, they don't want to go forward to work on problems in front of the class.

Regarding to the problem in indicator 4, all research subjects, including climbers, campers, and quitters, were not able to reach indicator 4 with good criteria. This is in line with research by Ekayanti & Nasyiitoh (2018) that students in the category of

climbers, campers, and quitters tend to make mistakes in terms of mathematical proof.

The analysis results of the climbers, campers, and quitters category students showed that in general the climbers category students had relatively high mathematical communication skills, the campers category students had moderate mathematical communication skills, and the quitters category students had relatively low mathematical communication skills. This finding is in line with research by Floresta, Suharto, & Diah (2015) regarding AQ leveling based on Wallas' stage, which found that students with high math abilities showed climbers indicators, students with moderate math abilities showed campers indicators, and students with low math abilities showed quitters indicators. The results of the analysis are also in line with research by Permata, Kartono, & Sunarmi (2015) which found that students in the high group classification get a high score of mathematical communication skills as well. The moderate group classification gets a score of mathematical communication skills at an average score. Meanwhile, the low group classification also scores low.

CONCLUSION

Based on the results of the research and discussion, it was concluded that after the implementation of the Disovery Learning model with realistic approach, the pattern of the climbers' mathematical communication skills was good categorized on indicators 1, 2, and 3, however it was enough categorized on indicator 4. The pattern of the campers' mathematical communication skills was enough categorized on all four indicators. The quitters' mathematical communication skills pattern was poor on all four indicators. There were excalations on the climbers' and the campers' mathematical communications skills, while the quitters did not show a significant excalation on those skills. All students (the climbers, the campers, and the quitters) have not been able to reach the good category on indicator 4.

REFERENCES

Asikin, M. & Junaedi, I. (2013). "Kemampuan Komunikasi Matematika Siswa SMP dalam Setting Pembelajaran RME (Realistic Mathematics Education)". *Unnes Journal of Mathematics Education Research*, 2(1): 203-213.

Dina, A., Mawarsari, V. D., & Suprapto, R. (2015). "Implementasi Kurikulum 2013 pada Perangkat Pembelajaran Model *Discovery Learning* Pendekatan *Scientific* terhadap Kemampuan Komunikasi Matematis Materi Geometri SMK". *JKPM*, 2(1): 22-31.

Ekayanti, A. & Nasyiithoh, H. K. (2018). "Profile of Students' Error in Mathematical Proof Process Viewed from Adversity Quotient (AQ)". *Tadris: Jurnal Keguruan dan Ilmu Tarbiyah*, 3(2): 155-166.

Fathurrohman, M. (2015). *Model-Model Pembelajaran Inovatif*. Jogjakarta: AR-RUZZ MEDIA.

Fatimah, F. (2012). "Kemampuan Komunikasi Matematis dalam Pembelajaran Statistika Elementer Melalui Problem Based-Learning". *Cakrawala Pendidikan*, 31(2): 267-277.

Floresta, K., Suharto, & Diah, N. (2015). "Pelevelan Adversity Quotient (AQ) Siswa Kelas VII F SMP Negeri 10 Jember dalam Memecahkan Masalah Matematika Sub Pokok Bahasan Persegi Panjang dan Segitiga dengan Menggunakan Tahap Wallas". *ARTIKEL ILMIAH MAHASISWA*, I(1): 1-6.

Izzati, N. & Suryadi, D. (2010). Komunikasi Matematik dan Pendidikan Matematika Realistik. *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika*, Yogyakarta, UNY, 27 Nov 2010, ISBN : 978-979-16353-5-6.

Lestari, K. E. & Yudhanegara, M. R. (2015). *Penelitian Pendidikan Matematika*. Bandung: PT Refika Aditama.

Marliani, L., Waluya, S. B., & Cahyono, E. (2019). "Mathematics Communication Skill of Students on Project Blended Learning (PB2L) with Moodle". *Unnes Journal of Mathematics Education Research*, 10(1): 85-91.

Mawaddah, N. E., Kartono, & Suyitno, H. (2015). "Model Pembelajaran Discovery Learning dengan Pendekatan Metakognitif untuk Meningkatkan Metakognisi dan Kemampuan Berpikir Kreatif Matematis". *Unnes Journal of Mathematics Education Research*, 4(1): 10-17.

NCTM. (2000). *Principle and Standards for School Mathematics*. National Council of Teachers of Mathematics: Reston VA.

OECD. (2019). *Programme for International Study Assesment (PISA): Result from PISA 2018*.

Pangastuti, L., Johan, A., & Kurniasari, I. (2014). "Profil Kemampuan Komunikasi Matematika Siswa SMP Ditinjau Dari Kecerdasan Emosional". *Mathedunesa Jurnal Ilmiah Pendidikan Matematika*, 3 (2): 127-133.

Permata, C. P., Kartono, & Sunarmi. (2015). " Analisis Kemampuan Komunikasi Matematis Siswa Kelas VIII SMP pada Model Pembelajaran TSTS dengan Pendekatan Scientific". *Unnes Journal of Mathematics Education*, 4(2): 127-133.

Sari, C. K., Sutopo, & Aryuna, D. R. (2016). "The Profile of Students' Thinking in Solving Mathematics Problems Based on Adversity Quotient". *Journal of Research and Advances in Mathematics Education*, Vol. 1, No. 36-48.

Savelsbergh, E. R., *et al*. (2016). "Effects of Innovative Science and Mathematics Teaching on Student Attitudes and Achievement: A Meta-Analytic Study". *Educational Research Review*, 19(2016): 158-172.

Sefiany, N., Masrukan, & Zaenuri. (2016). "Kemampuan Komunikasi Matematis Siswa Kelas VII pada Pembelajaran Matematika dengan Model Kinsley Berdasarkan Self Efficacy". *Unnes Journal of Mathematics Education*, 5(3): 227-233.

Shivaranjani. (2014). "Adversity Quotient: One Stop Solutiunto Combat Attrition Rate of Women in Indian Sector". *International Journal of Business and Administration Research Review*, 1(5): 181-189.

Stoltz, P. G. (2000). *Adversity Quotient: Mengubah Hambatan Menjadi Peluang*. Terjemahan T. Hermaya. Jakarta: Gramedia Widiasarana Indonesia.

Sugiyono. (2013). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung: Alfabeta.

Suhendri, H. (2018). "The Role of Resilience (Adversity Intelligence) and Creativity in Mathematics Learning". *UNNES JOURNAL OF MATHEMATICS EDUCATION*, 7(2): 90-94.

Sukestiyarno, Y. L. (2015). *Olah Data Penelitian Berbantuan SPSS*. Semarang: Universitas Negeri Semarang.

Wardani. (2010). *Implikasi Karakteristik Matematika dalam Pencapaian Tujuan Mata Pelajaran Matematika di SMP/MTs.*Yogyakarta: PPPPTK Matematika.

Wicaksono, D. B., Waluya, S. B., & Asih, T. S. N. (2019). "Mathematics Problem Solving Skill in ARIAS Learning with Scaffolding Strategy Viewed from Adversity Quotient based on Gender". *Unnes Journal of Mathematics Education Research*, 10(2): 128-133.

Zahroh, A. (2015). *Membangun Kualitas Pembelajaran Melalui Dimensi Profesionalisme Guru*. Bandung: Yrama Widya.

Zakiri, I. K., Pujiastuti, E., & Asih, T. S. N. (2018). "The Mathematical Communication Ability Based on Gender Difference on Students of XI Grade by Using Problem Based Learning Model Assisted by Probing Prompting Technique". *UNNES JOURNAL OF MATHEMATICS EDUCATION*, 7(2): 78-84.