Analysis mathematical communication ability of vocational student in osborn learning based on adversity quotient

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Abstract. In the global era, vocational students are required to be able to compete and have more abilities. One of them is mathematical communication skills in learning mathematics courses. However, vocational students' mathematical communication skills are low because students find it difficult to put mathematical problems into mathematical ideas or ideas. Adversity Quotient (AQ) is intelligence in facing difficulties. The Osborn model is a learning model that prioritizes students to have an opinion. Osborn's learning model with brainstorming techniques can train students to create ideas in a short time. This study aims to test the effectiveness of Osborn's learning in improving mathematical communication. The method used in this research is the Concurrent Embedded Strategy Mix Method. The subjects of this study were students of AKN Pacitan. Based on the data analysis, it was found that the effectiveness of learning was seen from the completeness of the students' mathematical communication skills, 1) Osborn learning proved to be effective because of a) more than 75% of the experimental class students achieved completeness, b) the average value of the experimental class mathematical communication skills was better than in the control class, c) AQ in the experimental class is better than the control class and d) the difference in communication skills at the beginning (pre-test) and the end (post-test) of the experimental class is better than the control class. 2) The subject of the quitter category has not been able to meet almost all indicators, the camper category is quite capable of several indicators, and the climber category can meet all indicators of mathematical communication.

1. Introduction

Communication is a routine activity of every interaction between two or more people, where in essence humans are social beings who cannot live individually, and this is necessary for humans to communicate between one another [1]. In addition, communication can also be interpreted as a way of conveying information from one person to another [2]. In the era of 4.0 vocational students are of course required to master skills in facing and preparing themselves to face challenges in the future. Mathematics as a subject that is studied at every level of education, from primary to tertiary education, an important role for the advancement of knowledge and technology [3]. Implementation of learning in mathematics courses at AKN Pacitan. AKN Pacitan is one of the vocational colleges for diploma 2 (D2). Vocational college students who should be required to have more abilities and skills as a provision to compete in the world of work, but students tend to still have difficulty communicating their ideas orally or in writing. Students still seem to lack confidence when presenting the material in front of the class. They only read the text in the reading, do not communicate it interestingly, so that other students do not really understand the material presented. This will also result in less than optimal
learning achievement, because students in communicating problems in the language of mathematics are still inaccurate. In accordance with the duties of the lecturer as an educator, namely to regulate intellectual activities of students in the classroom such as discussion and communication, the lecturer must cleverly manage the learning process that can foster mathematical communication for students. Mathematical communication is one of the determinants of success in learning mathematics, because mathematical communication skills are the ability of students to solve problems, express mathematical problems into mathematical ideas. This communication skill is important to develop because communication skills can help students understand the mathematical problems presented and answer math problems by expressing mathematical ideas in mathematical language so that solutions can be found. Mathematical communication have 4 indicators, there are 1) express situations, pictures, diagrams, or real objects into language, symbols, ideas or mathematical models, 2) explain an idea, situation, or mathematical relation through pictures, 3) present the solution of mathematical problems in detail and correctly, 4) check the validity of an argument. Indicators of mathematical communication skills in this research are divided into spoken and written. The indicators of mathematical communication skills in this study are:

| Aspect of Communication Skills | Spoken communication skills indicators | Written communication skills indicator |
|-------------------------------|----------------------------------------|---------------------------------------|
| 1. Write                      | Explain mathematical ideas verbally with real objects, pictures, graphs and algebra | Explain ideas in mathematical situations in writing with algebraic / mathematical concepts. |
| 2. Hear                       | Re-explain orally understand a mathematical concept. | Explains steps to solve mathematical problems that have been learned. |
| 3. Discussion                 | Express everyday problems or events in language or mathematical models. | Declare everyday events in language or mathematical symbols. |
| 4. Read                       | Draw conclusions about the mathematical concepts that have been studied. | Gain the ability to use mathematical notation as a means of presenting ideas related to problem solving with mathematical models. |

One learning model that can develop mathematical communication, especially in communicating ideas or ideas that they have, is the Osborn learning model. In previous research, Osborn learning was used to improve problem-solving abilities [7,8], mathematical creative thinking skills [9]. Osborn's learning model is a learning model using brainstorming methods or techniques [10]. The brainstorming method is an important method in creating ideas that can be obtained in a short time. The purpose of using the brainstorming method is (1) to assist students in solving problems with innovative solutions, (2) help students develop their thinking based on the ideas that appear in these learning activities, (3) help students integrate in building relationships between them and be able to assess each other. In other words, in the learning process using the brainstorming method in the Osborn learning model, students also have the task of responding to problems by expressing opinions, comments, asking questions, or raising new problems, learning and training to formulate their opinions with good language and sentences. Participate actively, and dare to express his opinion. Osborn learning can foster mathematical communication because Osborn learning is learning that uses the brain stroning method, students can construct their thoughts so that they can come up with ideas or ideas and can also express their ideas or ideas appropriately. Because students are required to be able
to actively participate in this learning so that students are motivated to master the learning material which is the topic of their discussion.

In addition to the frequently considered Intelligence Quotient (IQ) or Emotional Quotient (EQ), we also need to pay attention to the intelligence facing difficulties or Adversity Quotient (AQ) [11] which is very influential on one's success. Not only IQ or EQ determines a person's success, but AQ also has a tremendous influence in realizing one's success. A person's ability to face difficulties in life and turn them into an opportunity for success [12]. In dealing with problems in mathematics, AQ is a person's ability to face the difficulties that are being faced. students who easily give up on math problems are examples of students who have low AQ, when experiencing a difficulty they are not able to try harder to find a solution [13]. AQ has three categories, namely low called quitter, medium called camper, and high called climber [13]. AQ has four components namely control (C), recognition (O), reach (R), and endurance (E) [14]. There is a significant relationship between AQ and students learning outcomes [15], so that AQ also needs attention in the learning process. AQ of students are an important role in achieving effective learning, a learning is expected to optimize AQ so that the development of student learning achievement is maximized [16].

2. Research method
This research is a type of combined qualitative and quantitative research. The combination model used in this study is a concurrent embedded strategy type. Concurrent Embedded Strategy is a combination of qualitative and quantitative research methods carried out together, both in data collection and analysis, the weight between qualitative and quantitative research is different [17]. In this research, quantitative research is the primary method while quantitative research is the secondary method. Quantitative research is more emphasized and qualitative is used as supporting data to analyze the results of post tests for mathematical communication skills. The picture of the combined research is illustrated in Figure 1.

![Figure 1. Concurrent Embedded Design.](image-url)

In this research, population were students of AKN Pacitan in 2019/2020. There are 3 classes used as research samples according to the research design, the first is the experimental class, where learning in the experimental class applies the Osborn learning model. There are 3 classes used as research samples according to the research design, the first is the experimental class, where learning in the experimental class applies the Osborn learning model.

In this Research, used data collection techniques, including: observation, tests, and interviews. Data analysis was carried out from the pre-research stage to the analysis stage during the study. The analysis before the research was carried out by validating the research instruments and tools. The analysis in research is to systematically compile quantitative data obtained from observations, pre-test, post-test, and interviews. Analysis of quantitative data obtained from the results of learning achievement to determine the effectiveness of Osborn's learning, consists of: completeness test of mathematical communication with Osborn learning, test for differences in the proportion of students' mathematical communication ability between the experimental class and the control class, the AQ average difference
test between the experimental class and the control class, and the average difference test between the initial and final ability differences between the experimental class and control class. While the qualitative analysis in this study is data analysis in the experimental class using the Osborn learning model and the control class, namely the class in conventional learning using the Problem Based Learning (PBL) learning model. Where in each class group 9 students were selected based on the student's Adversity Quotient which was divided into 3 categories, namely quitter, camper and climber. In each category 3 students were selected where 1 student in the lower quartile (Q1), 1 student in the upper quartile (Q3) and 1 student in the median class for each AQ category. For the data from 9 selected students in each experimental and control class will be analyzed descriptively qualitatively.

3. Result and analysis

3.1 Quantitative Research Results

3.1.1 Hypothesis test 1 (Completeness test of experimental class)

Based on the results of calculations using a formula

\[ z = \frac{x - \pi_0}{\sqrt{\pi_0(1-\pi_0)/n}} \]

If, \( n = 36; \pi_0 = 0.75; x = 32 \)

so,

\[ z = \frac{32 - 0.75}{\sqrt{0.75(1-0.75)/36}} = \frac{0.8889 - 0.75}{\sqrt{0.0052}} = 0.0721 = 1.9265 \]

Because from the calculation of the \( z_h = 1.9265 \) is greater than the \( z_t = 1.645 \) with an error rate of 5% or 1.9265> 1.645, then \( H_0 \) is rejected. This means that the proportion of students who score mathematical communication skills more than 75%. So, it can be concluded that the classical learning completeness of the students' communication ability values with the Osborn learning model has been achieved.

3.1.2 Hypothesis test 2 (Test different proportions between sample classes)

Based on the results of calculations using a formula

\[ z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}\hat{q}(1/n_1) + (1/n_2)}} \]

with, \( \hat{p} = \frac{x_1 + x_2}{n_1 + n_2} \), and \( \hat{q} = 1 - \hat{p} \)

obtained a value for \( z_h = -6.51 \). For \( \alpha = 5\% \) obtained \( z_t = 1.64 \). Because \( z_h < -z_t \), so \( H_0 \) is rejected and \( H_1 \) is accepted. Based on the calculations obtained, it can be said the proportion of learning achievement results of students' mathematical communication abilities in the experimental class is better than the learning achievement results of students in the control class.

3.1.3 Hypothesis test 3 (Different test of the average adversity quotient of students in the experimental class with the control class)

Hypothesis testing by researchers using SPSS assistance. And the output data obtained are:

| Table 2. Independent samples test hypothesis test 3. |
|---------------------------------------------------|
| Levene's Test                                      |
| for Equality                                     |
| of Variances                                     |
| t-test for Equality of Means                      |
Based on the output in Table 2, it can be seen in the t-test column for Equality of Means values $t_b = 2.101$ and $t_t = 1.67$. Because $2.101 > 1.67$ so $t_b > t_t$, $H_0$ is rejected and $H_1$ is accepted. This information shows that the experimental class students' adversity quotient is better than the control class.

3.1.4 Hypothesis test 4 (difference test average difference between pre test and post test insample class)

Hypothesis testing by researchers using SPSS assistance. And the output data obtained are:

|                  | $F$  | Sig. | $t$  | Df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |
|------------------|------|------|------|----|----------------|------------------|----------------------|------------------------------------------|
| AQ_EK            | 3.402| .069 | 2.101| 70 | .039           | 15.611           | 7.430                | .793 to 30.430                      |
| SPERI            |      |      |      |    |                |                  |                      |                                          |
| MEN_             |      |      |      |    |                |                  |                      |                                          |
| KONT_            |      |      |      |    |                |                  |                      |                                          |
| ROL_             |      |      |      |    |                |                  |                      |                                          |

From the output in Table 3, it can be seen $t_b = 1.913$ and $t_t = 1.67$. Because $t_b > t_t$ so $H_0$ is rejected and $H_1$ is accepted. Which means that the difference between the beginning and the end of the mathematical communication of the experimental class students is better than the difference between the beginning and the end of the control class mathematical communication.

3.2 Qualitative research results

3.2.1 Analysis of mathematical communication ability in osborn learning based on adversity quotient

In Osborn's learning, most of the groups of students who had AQ with the quitter category could not achieve the four indicators of written mathematical communication skills. The high enough indicator obtained by students with the quitter category is the third indicator in mathematical communication skills, namely explaining the steps to solve mathematical problems that have been learned. For the camper category, most students can achieve the four indicators of mathematical communication ability
in writing, it's just that in the achievement of each indicator is less than optimal, for example in the achievement of the first indicator, students in the camper category can achieve the first indicator only in providing reasons or solutions, he gave a concept that was not in accordance with what he was learning but the concept was also acceptable. And for the climber category, most students have achieved well-determined indicators, almost all indicators can be fulfilled properly. Most students in the climber category can achieve the four indicators of mathematical communication skills maximally.

3.2.2. Analysis of Mathematical Communication Ability in Convensional Learning Based on Adversity Quotient
Mathematical communication skills in convensional learning, where conventional means the application of the PBL model. Problem Based Learning (PBL) can be applied to achieve mathematical communication skills, it's just not recommended to be applied in improving mathematical communication skills. Students' mathematical communication skills taught with the PBL model are no better than ordinary learning, because PBL is more suitable to be used to improve problem-solving abilities[18]. In PBL learning groups of students who have AQ with the quitter category are mostly unable to achieve the four indicators of mathematical communication skills in writing. Most students in this category still find it difficult to accept and work on the questions given. For the camper category, most students can do it, three of the four indicators can be fulfilled properly by students in this category even though their achievement towards the indicators of mathematical communication skills is still not optimal. The results of his work are unclear and not easy to understand. And for the climber category, most students can achieve several indicators well, in this category students can provide answers and solutions that are acceptable even though they are less than perfect.

4. Conclusion
Osborn learning is learning that is proven effective in improving vocational students' mathematical communication skills. Therefore, lecturers need to develop Osborn learning in mathematics learning. For further research, it can be developed by combining other learning that can improve mathematical communication ability. Aside from that the Osborn learning model with this brain stroming method can be used to improve other abilities.

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