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Increasing Students' Mathematical Communication Ability Through Web-Based Learning

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Abstrak

Penelitian ini bertujuan untuk mengetahui peningkatan kemampuan komunikasi matematis siswa kelas X SMK Dwi Putra Bangsa dengan pembelajaran berbasis web. Subjek penelitian ini adalah siswa kelas X SMK Dwi Putra Bangsa yang diambil 2 kelompok. Kelompok pertama sebagai kelompok eksperimen yang diberi perlakuan pembelajaran berbasis web dan kelompok kedua sebagai kelas kontrol yang diberi perlakuan pembelajaran ekspositori. Pembelajaran yang tepat dapat meningkatkan kemampuan komunikasi matematis dengan salah satu indikator yang diperlukan yaitu menyatakan situasi matematik atau peristiwa sehari-hari ke dalam model matematika dan menyelesaikannya. Metode pengumpulan data menggunakan metode kuasi eksperimen dan teknik sampling yang digunakan dalam penelitian ini adalah *purposive sampling*. Diperoleh hasil perhitungan bahwa $t_{hitung} > t_{tabel}$ hal ini berdasarkan dari uji t N-gain dimana $t_{hitung} = 2{,}22$ dan $t_{tabel} = 2{,}01063$ pada tarap signifikan 0,05. Hal ini menyimpulkan bahwa terdapat peningkatan kemampuan komunikasi matematis siswa X SMK Dwi Putra Bangsa dengan pembelajaran berabasis web.

Kata kunci: Pembelajaran Berbasis Web, Kemampuan Komunikasi Matematis, Kuasi Eksperimen

Abstract

This study aims to determine the increase in mathematical communication skills of class X SMK Dwi Putra Bangsa with web-based learning. The subjects of this study were students of class X SMK Dwi Putra Bangsa who were taken in 2 groups. The first group as an experimental group that was given web-based learning treatment and the second group as a control class that was given conventional learning treatment. Appropriate learning can improve mathematical communication skills with one of the indicators needed, namely expressing mathematical situations or everyday events into a mathematical model and solving them. The data collection method used was a quasi-experimental method and the sampling technique used in this study was purposive sampling. The results of the calculation that tcount> ttable, this is based on the N-gain t test where tcount = 2.22 and ttable = 2.01063 at a significant tarap 0.05. This concludes that there is an increase in the mathematical communication skills of students X SMK Dwi Putra Bangsa with web-based learning.

Keywords: *Web Based Learning, Mathematical Communication Skills, Quasi-Experimental*

1. INTRODUCTION

The quality of education in Indonesia is still considered low, this can be seen from the results of the Trend In International Mathematics and Science Study (TIMSS) test, an institution that measures and compares the mathematical abilities of students between countries, students' mastery of mathematics level 8. In 1999 Indonesia was ranked 32 out of 38 countries studied. In 2003 Indonesia was ranked 36th out of 45 studied, in 2007 Indonesia was ranked 41st out of 48 countries studied the average score obtained by Indonesian students was 397. This score is still far from the international score of 500 Setiawan (Khadijah , Maya, and Setiawan, 2018).

Through communication, students can convey their ideas to the teacher and to other students. Based on this, students' mathematical communication skills must be considered by every teacher. By communicating his mathematical ideas to others, a student can improve his mathematical understanding. And it can be concluded that mathematical communication is an essential mathematical basic ability and needs to be possessed by high school students (SM) (Ismarwan, 2013).

Communication in general can be interpreted as a way to convey a message from the messenger to the recipient of the message to inform, opinion, or behavior either directly orally or indirectly through the media. Baroody (Hendriana and Kadarisma, 2019) mathematical communication is an asset in solving, exploring, and investigating mathematics, as well as a means of social activity in exchanging thoughts, opinions, and being able to sharpen ideas in convincing others. One form of mathematical communication is the activity of understanding mathematics. Understanding mathematics has a central role in learning mathematics, because understanding activities encourage students to learn meaningfully actively. Communication in the classroom occurs between the teacher and students, where the method of transferring the message can be orally or in writing.

In communicating, you have to think about how to make the message conveyed by someone else be understood by others. To develop communication skills, it can be conveyed in various languages, one of which is mathematical language. One of the goals of learning mathematics in schools is for students to have the ability to communicate ideas with symbols, tables, diagrams, or other media to clarify situations or problems (Depdiknas, 2006). In addition, communication is one of the learning experiences that students must experience in the learning process in each subject (Permendikbud Number 81A, 2013).

The ability to understand and communicate mathematics is fundamental and an important component in the process of learning mathematics to make it easier for students to understand concepts and solve problems at a higher level. If students do not understand a concept, then these students will have difficulty understanding other concepts. Turmudi (2009) reveals that by understanding mathematics students will be able to apply mathematical procedures, concepts, and processes. The model of presenting material in learning mathematics is one of the interesting factors to be studied and researched. The reality on the ground, learning mathematics has not been able to fully develop students' basic mathematical abilities such as mathematical communication.

Mathematics learning in general is still centered on the teacher, and uses an expository approach. Sanjaya (2009: 1) reveals that in this learning process students become passive, communication between students and students and between students and teachers is low, communication is limited

to short verbal answers to questions posed by the teacher. Wahyudin (2008) reveals that expository learning which is usually done every day at school is less effective for students. In expository learning, most students follow well every explanation from the teacher, students rarely ask questions to the teacher, so the teacher is engrossed in explaining what he has prepared. With the practice of expository learning students only receive information conveyed by the teacher, and the teacher has difficulty knowing whether students have understood the material that has been delivered, so that the results of students' ability tests on certain materials are below the specified standards.

Turmudi (Sutarto, 2018: 14) argues that mathematics learning has so far been conveyed to students in an informative manner, meaning that students only get information from the teacher, so that the degree of attachment can also be said to be low. This causes the concepts given to not make an impression on the child's memory, so that the child is confused in solving the problems given by an educator. Tjalla (2010: 24) reveals that based on the results of research by the International Association for the Evaluation of Education Achievement (IEA) from 49 countries participating in the Trends International Mathematics and Science Study (TIMSS) 2007, Indonesian student achievement in mathematics is in 2nd place 36, with an average score of 405 (international mean score = 500). In terms of achievement in learning Mathematics, the five best rankings in the world are occupied by Taiwan followed by South Korea, Singapore, Hong Kong and Japan. Indonesia's position is still much better compared to Syria, Egypt, Algeria, Columbia, Oman, Palestine, Botswana, Kuwait, Alsavador, Saudi Arabia, Ghana, Qatar and Morocco. In general, the TIMSS 2007 results show that our students have basic knowledge of mathematics, but not enough to be able to solve routine problems (manipulation of shapes, choosing strategies, and so on) let alone non-routine ones (intuitive and inductive reasoning based on patterns and regularities).

Mathematics is one of the subjects contained in the curriculum structure and is taught at every level of the educational unit. One of the mathematical competencies that must be possessed is the ability to communicate mathematical ideas clearly. In line with the National Council of Teachers of Mathematics (NCTM, 2000), one of the objectives of learning mathematics is to learn to communicate (mathematical communication). Communication is an attempt by a person or with other people to build togetherness with other people by forming relationships in sharing or using information together. There are two ways of delivering messages, namely: (1) direct delivery from the sender of the message to the recipient of the message without using the media (2) indirect delivery, namely using the delivery media. Mahmudi (2009) stated that in learning mathematics students are expected to be able to communicate ideas with symbols, tables, diagrams or other media to clarify the state of a problem. This shows the importance of communication skills to be mastered by students.

Based on the results of observations and interviews with one of the mathematics teachers at Dwi Putra Bangsa Vocational School, mathematics learning has been carried out in an expository way by explaining the material and pictures in the book. Students seem to have difficulty understanding mathematics at school so that learning activities are less than optimal. This is evidenced in the results of the average Odd Semester End Assessment (PAS) for class X, namely 60, which is still far from the Minimum Completeness Criteria (KKM) target, namely 70. From the results obtained, students at the school still have difficulty writing back what what he already knew, and when presented with a diagram or problem in the form of a table, he was then asked to state it again in front of the class, he still experienced problems. In addition, students rarely ask questions even though they do not

understand the material presented by the teacher, which means that indirectly the students' mathematical communication skills are still relatively weak. If learning mathematics focuses on memorizing terms rather than communicating mathematical ideas, students experience many difficulties, so it is necessary to introduce a learning model that is used by the teacher in the teaching and learning process earlier.

Sugandi and Benard (2018: 17) reveal that communication skills are important to develop because communication skills can help students understand the mathematical problems presented and present ideas for solutions and problems, as well as provide the arguments they present. Before students communicate mathematical ideas, of course students must understand the mathematical problems being studied. When participants do not understand mathematical problems, students will have difficulty conveying mathematical ideas to others. This will be related to the communication process with the readiness of students, because students must understand mathematical problems through their thoughts that have been studied.

The message that is diverted contains the mathematical material that students are studying, for example in the form of concepts, formulas, or strategies in solving a mathematical problem. Parties involved in communication events in the classroom are educators with students. How to transfer the message can be verbal or written. Communicating a statement or idea in simple mathematical language is even more practical and efficient. Sari (2015: 3) reveals that aspects of mathematical communication skills are grammar skills, the ability to understand discourse, sociolinguistic abilities, and strategic abilities. Mathematical communication is both physical and mental activity in listening, reading, writing, speaking, reflecting and demonstrating and using language and symbols to communicate mathematical ideas. To see students' mathematical communication abilities in learning mathematics can be seen from the indicators of mathematical communication abilities.

Nayazik and Wahyuni (2017: 108) reveal that students' low mathematical communication skills in communicating their ideas are still hesitant, so that when there are problems presented in the form of word problems they are still confused about solving them and difficulties in making mathematical models. In the learning process students still depend on the teacher's explanation. The teacher conveys the material he has prepared, students only listen and write down the information conveyed, students become passive and have less opportunity to express opinions. Whereas students should be able to explain subject matter based on their own words according to their understanding. Mathematical communication is important because mathematics is seen as a communication tool in the sense that mathematics is a language of symbols which is depicted in the process of symbolization and formulation, namely changing statements into formulas, symbols or pictures. The language of symbols implies that mathematics is universal and can be understood by everyone anytime and anywhere. Each symbol has a clear meaning, and is mutually agreed upon by everyone. With the language of symbols in mathematics, communication between individuals or communication between individuals and an object becomes easier. With discussions in groups, conversations that reveal mathematical ideas will help students hone their minds, so that they will understand mathematics better.

The communication process also helps students develop their own language to express mathematical ideas, and helps build understanding and accuracy of ideas and makes them conveyable to others. The form of communication used by the teacher greatly influences the success of the learning

process. In learning mathematics, multi-directional forms of communication can help students hone their ability to communicate, convey, and express their mathematical ideas. Multi-way communication can occur when students learn through group learning. With discussions in groups, conversations that reveal mathematical ideas will help students hone their minds, so they will understand mathematics better. Yanti, et al., (2018: 86) revealed that the communication process will help build the meaning and stability of ideas in the minds of students. Students who work actively in groups in presenting data, show progress when listening, and discuss together in concluding the group's subject matter.

When there is a discussion between students communication skills are very important, where students are expected to be able to state, explain, describe, listen, ask and work together, so as to bring students to a deep understanding of mathematics. Communication ability is seen as a student's ability to communicate the mathematics he is learning as the content of the message that must be conveyed. Wahyudin (Rachmayani, 2014: 14) reveals that communication can support students' learning of new mathematical concepts, when they play roles in situations, take, use objects, give reports and oral explanations, use diagrams, write , and use mathematical symbols.

Mathematical communication ability is the ability of students to convey mathematical ideas both orally and in writing. Students' mathematical communication skills can be developed through the learning process at school, one of which is the process of learning mathematics. This happens because one of the elements of mathematics is logic which is able to develop students' thinking skills. Thus, mathematics has an important role in the development of mathematical communication skills. NCTM (Hodiyanto, 2017: 12) reveals that in the Principles and Standards for School Mathematics, formulates communication standards to guarantee mathematics learning activities that are able to develop students' abilities, namely: 1) Arranging and integrating mathematical thinking through communication; 2) Communicate mathematical thinking logically and systematically to fellow students, teachers and other people; 3) Analyze and evaluate other people's mathematical thinking and strategies; 4) Using mathematical language to express mathematical ideas precisely.

Hendriana & Soemarno (2014: 77) revealed that indicators of students' abilities in mathematical communication in mathematics learning can be seen from: 1) Expressing mathematical situations or everyday events into mathematical models and solving them; 2) Expressing mathematical models (pictures, algebraic expressions) in ordinary language (composing story problems); 3) Give an explanation of the mathematical model and or pattern; 4) Compose questions about the given situation with reasons. Based on some of the opinions above, mathematical communication indicators that will be used in research include expressing mathematical situations or everyday events into mathematical models and solving them, stating mathematical models (pictures, algebraic expressions) into ordinary language (composing story problems), giving explanation of mathematical models and/or patterns as well as compiling questions about the given situation with reasons.

Web-based learning is learning by utilizing the internet network to communicate and convey learning information. The software used in the learning process is xampp in the form of a blog. This blog contains a description of the material written in detail which is delivered to students. Students are led to study it independently or in groups, so that students get an overview of the material presented. Rusman (2012: 357) reveals that web-based learning has characteristics, namely, 1) Interaction, there are lines of communication, both directly such as chatting and indirectly such as mailing list forums; 2) Independent, flexibility in the aspect of providing time, place, instructor and

teaching materials so that learning is more centered on students; 3) Access, learning resources are more accessible through distribution on the internet network with wider access than the distribution of learning resources in expository learning; 4) Enrichment, learning activities, presentation of materials and training materials as enrichment, enabling the use of information technology tools, such as video streaming, simulations and animations. Rusman (2012: 347) reveals that the learning steps are web-based, namely, 1) The teacher directs learning through the web network that has been provided; 2) The teacher delivers learning materials or problems to students according to the basic competencies to be achieved; 3) The teacher asks students to ask questions related to the material they have learned from the web; 4) The teacher encourages asking questions related to material that has been learned from the web; 5) The teacher poses problems to be solved together through chatting or mailing list forums; 6) The teacher checks students' understanding by demonstrating their understanding.

2. METHOD

The method used in this study is a quasi-experimental method. The use of this method aims to determine the extent to which the influence of the independent variables on the dependent variable, where the independent variable is web-based learning while the dependent variable is students' mathematical communication skills. In this study the subjects were not grouped randomly, but the research subjects used existing groups. The research design used was a pretest-posttest control group design.

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The population in this study were all students of SMK Dwi Putra Bangsa. The sample was class X students of Dwi Putra Bangsa Vocational School who were selected based on class, namely students X A and students in class X B. The instrument used was a description test consisting of 5 questions that had been tried out at the same school to determine the validity of the instrument. The data obtained is in the form of quantitative data from the results of the pretest and posttest results. The pre-test and post-test results were analyzed using parametric statistics with the t-test, because the data obtained were normally distributed and homogeneous, both pre-test and post-test data.

3. RESULT AND DISCUSSION

This research was conducted at the Dwi Putra Bangsa Vocational High School in class X. The research was conducted in several meetings, at the first meeting the students were given a pretest and the final meeting was given a posttest. In the second meeting, students were given treatment with web-based learning. This learning can use a computer or use a mobile phone connected to the internet network. Students can open the website that has been provided, where learning material has been provided on the blog. Students just have to study the material that has been prepared on the website.

The teacher is a determining factor for the success of a quality learning process, so that the success or failure of education in achieving its goals is always linked to the teachers. Therefore, the efforts made to improve the quality of education should start with improving the quality of teachers. Qualified teachers include teachers who know and understand their roles and functions in the learning process.

Research on the application of a web-based learning model to improve the mathematical communication skills of class X students of SMK Dwi Putra Bangsa aims to determine the increase

in the mathematical communication skills of class X students of SMK Dwi Putra Bangsa by using a web-based learning model.

Student learning outcomes are seen from the difference in student pretest and posttest scores which is called the N-Gain from the experimental class and the control class. N-Gain is statistically tested to ensure that there is an increase in students' mathematical communication skills. From testing the hypothesis with the t-test, the value of tcount > ttable is obtained, so there is a difference in the increase in the mathematical communication abilities of the experimental class and control class students. The web-based learning process is as shown in Figure 1 below.

Figure 1. Web-Based Learning

Web-based learning is carried out by students of this experimental class through computers that are available at school. Each student was directed to open a web that had been prepared by the researcher, students accessed the web to study mathematical material about a three-variable system of linear equations. The results of the analysis of improving the mathematical communication skills of students who receive web-based learning with students who receive expository learning are shown in Table 1 below.

Table 1. Descriptive N-Gain Data

Class	Mean	Std. Deviation	Maximum	Minimum
Eksperiment	.5146	.20756	.83	.14
Control	.3721	.17250	.73	.15
Total	.4462	.20279	.83	.14

Based on Table 1, the average N-Gain of students who get web-based learning is 0.5146, while the average of students who get expository learning is 0.3721. The standard deviation of students who received web-based learning was 0.20756, while the standard deviation of students who received expository learning was 0.17250. The average N-Gain score of the experimental class students is higher than that of the control class students. This means that the average N-gain score of the experimental class students is better than the average N-gain value of the control class. The increase in mathematical communication skills who get web-based learning is better than students who get expository learning.

Table 2. Normality Test

	Shapiro-Wilk		
Class	Statistic	Df	Sig.
Eksperiment	.950	26	.226

Control	.917	24	.050

Based on Table 2 using the Shapiro-Wilk test for N-Gain data for experimental class student data, the value of Sig. = 0.226, because the value of Sig. = 0.226 more than 0.05, then H0 is accepted, meaning that the N-Gain data of experimental class students is normally distributed. The N-Gain data of the control class students obtained the value of Sig. = 0.050, because the value of Sig. = 0.050 equals 0.05, then H0 is accepted, meaning that the N-Gain data for the control class is normally distributed. Because the N-Gain data for both classes are normally distributed, the statistics used to see the mean difference are parametric statistics with the t-test.

Table 3. Homogeneity Test

Levene Statistic	df1	df2	Sig.
1.762	1	48	.191

Based on Table 3, the homogeneity test of variance with the Levene test obtained a significance value of 0.0191, because the Sig. 0.191 is more than 0.05, then H0 is accepted, meaning that the N-Gain data for the experimental class and control class come from homogeneous data or the samples used in this study come from the same population.

Table 4. Uji-t

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Nilai	Equal variances assumes	1.762	.191	2.628	48	.011	.14253	.05423	.03350	.25156
	Equal variances not assumed			2.648	47.502	.011	.14253	.05382	.03429	.25078

Based on the normality and homogeneity tests, it turns out that the N-Gain data for the experimental class and control class are normally distributed and have a homogeneous variant. Therefore, the statistic used to see the mean difference is parametric statistics with the t-test. The t-test is used because the N-Gain data for the experimental class and the control class are not related to each other. The increase in the mathematical communication skills of the experimental class students was not affected by the increase in the control class students' mathematical communication abilities. Likewise, the increase in the mathematical communication ability of the control class students was not affected by the increase in the mathematical communication ability of the experimental class students. Based on Table 4, Sig. (2-tailed) 0.011. Because the significance value is less than 0.05, Ho is rejected. This means that there are differences in the improvement of the mathematical communication abilities of students who receive web-based learning and students who receive expository learning.

Based on the results of the data analysis, it turns out that the mathematical communication abilities of those who receive web-based learning are better than students who receive expository learning. This is because web-based learning involves students directly in the learning process. In web-based learning students are involved in learning planning so that students choose their own learning style according to their habits. Web-based learning gives more freedom to students in studying the material provided, so that students can study according to their abilities. Web-based learning makes students more active, because students can build their own ideas according to what they have

learned. Learning that is adapted to students' habits causes students' memories to be longer than learning that is not in accordance with habits. Therefore, students who are given the freedom and opportunity to learn on their own, of course, will be more confident and will recognize themselves more and more.

4. CONCLUSION

Based on the results of data analysis and statistical hypothesis testing, it was concluded that the mathematical communication skills of students who received web-based learning were better than students who received expository learning. The results of the study show that web-based learning has a good influence on students' mathematical communication skills, so that web-based learning can be used as an alternative in choosing and applying a method in the process of learning mathematics to create freedom for students in understanding the subject matter.

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