

# Evaluation of Mathematic Communication Ability in the Environment Blended Learning in Algebra

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**Abstract** -The purpose of this study is to describe the mathematical communication skills of students in the blended learning environment of algebra courses. As a research subject, first semester students in the academic year 2019/2020 mathematics education study program Faculty of Teacher Training and Education, Pancasakti University, Tegal. Research data obtained by observation, interview and documentation. The data obtained are mathematical communication skills data, then performed data reduction, data analysis and presented a qualitative form then drawn conclusions. The results showed that students' mathematical communication skills can be described in each indicator of students' mathematical communication abilities in learning Algebra.

**Keywords:** *mathematical communication, blended learning, learning independence*

## I. INTRODUCTION

Mathematics has been known by students since elementary school, mathematics is one of the fields of study that is always present in the elementary and secondary education curriculum. By studying mathematics implanted noble values of mathematics that can be used in life such as discipline, diligent, careful, tenacious, independent, honest, tough, democratic. The benefits of mathematics in everyday life as a tool to solve problems, can be said that mathematics as a servant of science. As a science, mathematics also functions to serve other sciences. Mathematics grows and develops for itself as a science and as a service provider for the development of other sciences as well. (Suherman, et al, 2001: 29).

Everyday life solving problems in using mathematics include measuring, calculating, comparing, predicting and others. Therefore mathematics is very important to be studied by students of mathematics education for the development of mathematics and the development of science and technology in general.

Mathematics has many branches that are

interrelated to one another, both direct and indirect links. One branch of mathematics is Algebra, with algebraic facts, concepts and mathematical structures introduced to students earlier.

Mathematics education students of the Teaching and Education Faculty (FKIP), University of Pancasakti (UPS) Tegal come from various public and private schools, namely Senior High Schools (SMA), Madrasah Aliyah (MA) with various majors and Vocational High Schools (SMK) with various skill.. The diversity of majors from schools with different mathematics curriculum between High School / MA mathematics curricula (natural sciences majors, social sciences majors, language majors) and SMK with various skills, these differences in mathematics curriculum cause differences in students' basic mathematical abilities.

Mathematical communication is one of the knowledge that needs to be developed to students of mathematics education, with mathematical communication students can use the terms, symbols to express mathematical ideas verbally, writing, drawing and visually, as well as interpret and evaluate mathematical ideas appropriately. This is in accordance with NCTM (2000) argues that indicators of mathematical communication competence in mathematics learning consist of: (1) The ability to express mathematical ideas through oral and written expressions, and to visually demonstrate and describe them; (2) The ability to understand, interpret, and evaluate mathematical ideas correctly verbally and in other visual terms; (3) The ability to use mathematical terms, notations and structures to present ideas, picture relationships and situational models.

Mathematical communication needs to get attention in mathematics learning, because with communication students can organize mathematical thinking (NCTM.2000)<sup>(2)</sup> according to NCTM (1989) the role of communication for students to: (1) Organize and combine their mathematical thinking

through communication; (2) Communicate their mathematical thinking coherently and clearly to peers, teachers, and others; (3) Analyzing and evaluating the mathematical thinking and strategies of others; (4) Use mathematical language to express mathematical ideas appropriately.

Communication in mathematics is a very important part of mathematics education (NCTM 200; Cai, 1996<sup>(4)</sup>; Barrody, 1993<sup>(5)</sup>; Pugalee, 2001)<sup>(6)</sup> According to Barrody (1993)<sup>(5)</sup> provides reasons why communication has a very important role in learning mathematics, namely (1) mathematics is language (mathematics as language); mathematics is not just a tool to help thinking, a tool to find patterns, an invaluable tool for communicating ideas clearly, precisely and smoothly (an invaluable tool for communicating a variety of ideas clearly, precisely and succinctly). (2) Mathematics as a social activity (mathematics as social activity), in learning mathematics, such as inaction between students, teacher-student communication is an important part in maintaining the mathematical potential of children (nurturing children's mathematical potential). Furthermore communication skills according to Clark (2005: 2)<sup>(7)</sup>; 'discourse communities are those in which students feel to express their thinking, and take responsibility for listening, paraphrasing, questioning, and interpreting one another's ideas in whole class and small group discussions'. In other words, mathematical communication is the ability of students to express ideas obtained through listening, making their own sentences, asking questions, communicating in class by presenting messages contained in mathematical problems.

Communication according to Clark (2005: 1)<sup>(7)</sup> is a very important part in mathematics. Bisaid that, Clark stated that mathematical communication is a way of sharing ideas and clarifying understanding. Through communication, ideas become objects of reflection, refinement, discussion, and amendment. The communication process helps build meaning and permanence for ideas and makes them public. Communication is a way to share ideas and clarify understanding. Through communication ideas can be reflected, reflected, improved, discussed and developed. The communication process helps to build understanding and perpetuate ideas and make them public. When a student is given a mathematical problem and is required to convey ideas verbally and in writing, they are actually doing learning activities explaining and convincing the problem. This activity can foster independence in learning mathematics.

The role of mathematical communication is very important in mathematics learning, according to Clark mathematical communication acts as: (1) a tool to exploit mathematical ideas and help students' abilities in seeing the various relationships of mathematical material, (2) a tool to measure the growth of understanding and reflecting understanding

of mathematics in students, (3) tools to organize and consolidate students' mathematical thinking, and (4) tools to construct mathematical knowledge, develop problem solving, increase reasoning, foster self-confidence, and improve social skills.

Student success in learning is influenced by various factors, both internal and external factors. One factor in students is student independence in learning. In learning mathematics required good independence of learning. Characteristics of students have independence according to Sukarno, Anton (1989: 64)<sup>(8)</sup> mentions the characteristics of learning independence as follows: (1) Students plan and choose their own learning activities; (2) Students take the initiative and encourage themselves to learn continuously; (3). Students are required to be responsible for learning; (4) Students learn critically, logically, and are full of openness; (5) Students learn with confidence. While Susilawati, Desi (2009: 7-8)<sup>(9)</sup> describes learning independence as: (1) Students are trying to increase responsibility in making various decisions; (2) Independence is seen as a trait that already exists in every person and learning situation; (3) Independence does not mean separating from others; (4) learning independent can transfer learning outcomes in the form of knowledge and skills in a variety of situations; (5) Students who study independently can involve a variety of resources and activities such as self-reading, group learning, exercises and correspondence activities; (6) The effective role of the teacher in independent learning is still possible such as dialogue with students, finding resources, evaluating results and developing critical thinking; (7) Some educational institutions find ways to develop independent learning through open learning programs.

Students who have good learning independence will have responsibility for the tasks and obligations imposed by the lecturer, be timely in completing assignments, do not depend on others, have initiative, are creative and efficient in completing assignments. Therefore learning independence is very necessary in the process of learning mathematics.

To improve the qualifications of prospective mathematics teachers, we need a learning process that is adapted to the development of science and technology. Current learning that utilizes information technology uses e-learning. E-learning is learning that utilizes information and communication technology, especially in the form of electronics. That is, not only the internet, but all electronic devices such as films, videos, tapes, OHPs, slides, LCDs, projectors, and others. E-learning learning is carried out online by utilizing computers that are connected to the internet or using mobile phones. So learning is not limited to distance, space and time, it can be done anywhere.

The learning process is usually done in a face-to-face manner to carry out discussion of

material, assignments as well as discussions. In face-to-face learning, there is direct communication between students and lecturers which is carried out in one space / place and time that has been determined and agreed upon jointly by the lecturer and students. Learning can also be done by combining face-to-face learning and e-learning or online learning as it is known as blended learning (Reay, 2001; Rooney, 2003; Graham, 2006). Many universities today use a blended learning approach for various purposes such as increasing the number of students enrolled (Dziuban, Hartman, Juge, Moskal & Sorg, 2006) and to provide effective ways to communicate with students (Borup, Graham & Velasquez, 2006). Dziuban et al. (2006) reported that blended learning at the University of Central Florida was popular with students, and enrollments increased from 125 in 1997 to more than 13,600 in 2003-2004. In addition Blended learning can offer a higher level of interaction than is commonly experienced in face to face (Dziuban, Hartman & Moskal, 2004; Wingard, 2004).<sup>(13)</sup>

The results of research conducted by (Dziuban et al., 2004; 2006)<sup>(13)</sup> found that blended learning can improve student learning outcomes while reducing the level of student erosion. Other findings obtained that blended learning success does not occur automatically. Key factors in blended learning need to consider pedagogical and instructional designs related to how to utilize technology tools, how to facilitate interaction between students, how to motivate students to participate in discussions and what content is best displayed via the internet compared to face to face.

Blended learning implementation combines online learning and face-to-face learning. At the time of face-to-face learning, lecturers and students are in one room and interact directly, exchange information, learn independently (like using modules), while when learning online lecturers and students are not always in one room, students learn independently online, material lecturers uploaded or relevant material can be accessed through the internet using computer or mobile facilities. Blended learning is an effective way to communicate with students (Borup, Graham & Velasquez, 2006). Thus blended learning can build student mathematical communication in learning teaching material, completing individual assignments and group assignments.

FKIP UPS Tegal mathematics education students come from SMA/ MA and vocational schools with various majors having different basic mathematical abilities, this is caused by differences in the curriculum that applies to each department at each school level. Differences in basic mathematical abilities will also affect mathematical communication skills for each student. Therefore it is necessary to build communication skills, as a provision in learning

further mathematics to be transferred to students after they have served as teachers.

The learning independence of students in learning also needs attention, because students in learning mathematics still behave like when in middle school, have not been able to break away from study habits that are mostly controlled by teachers. One solution to building mathematical communication is by learning in a blended learning environment.

## II. METHOD

This type of research is qualitative research. The research aims to describe the mathematical communication skills (in writing) of students through the provision of algebraic application problems that are packaged in learning the blended learning environment on the subject matter of function. The subjects of the study were the first semester mathematics education students as much as 44 students in algebra. For the purposes of analysis, two students from the SMA / MA majors of Natural Sciences were selected, SMA/MA majors of Social Sciences and SMK from various skill. Data analyzed were data from students' mathematical communication in writing and interviews were completed to complete the written data.

The problem solving instruments that were solved by students with function material in algebraic curriculum and then analyzed their mathematical communication skills were as follows:

1. A bullet is fired upward, after  $t$  seconds reaches the height  $h(t) = 60t - 3t^2$ .
  - a. When does the bullet reach maximum height?
  - b. Determine the maximum height of the bullet?
  - c. When will the bullet reach the ground again?
2. A quadratic function will be a good function graph model. Given points  $(1, -4)$ ,  $(-1, -6)$  and  $(2, -9)$  are the coordinates that the function graph passes.
  - a. Determine the equation of the function!
  - b. Paint the chart!
  - c. Explain the properties of the graph!
3. A rectangular paper with a length twice the width. In the four corners it is cut into a 2cm square shape and then a piece of paper is formed so that the beam volume is 480 cm<sup>3</sup>.
  - a. Show me the sketch of the block!
  - b. Determine the size of the block!

To find out the communication skills of students the indicators and rubrics are determined as in table.1.

The research data obtained are data from mathematical communication skills in writing for each indicator. To complete the data on written communication skills, interviews with students are needed. Then the data is analyzed descriptively. To give an overview of the results of the research given examples of student writing in solving problems.

Table1: Mathematical communication indicators and rubrics

| No. | Indicators (General Criteria)   | Rubrics (Specific Criteria)   |
|-----|---|---|
| 1   | Describe the situation of mathematical problems and mathematical ideas in written and oral form Students are able to write what is known and asked which is the essence of a problem.   | Students are able to write down what is known and asked which is the essence of a problem   |
|     | Describe problem situations and state the design of problem solutions using algebraic formulas or drawings Students are able to sketch pictures or make mathematical sentences in the form of algebraic formulas to explain problems and determine the formulas used. | Students are able to sketch pictures or make mathematical sentences in the form of algebraic formulas to explain the problem and determine the formulas used. |
| 3   | Using mathematical symbols, ideas, structures and sentences to solve everyday problems Students are able to use mathematical symbols, ideas, structures and sentences to solve everyday problems  | Students are able to use mathematical symbols, ideas, structures and sentences to solve everyday problems.  |
| 4   | Using comprehensive representation to express mathematical concepts and solutions Students are able to explain problems and connect problems by making graphs, pictures or mathematical expressions that have been made   | Students are able to explain problems and connect problems by making graphs, pictures or mathematical expressions that have been made.                        |
| 5   | Building a problem or a particular case of a particular mathematical model (graphs, pictures, and mathematical expressions) Students can explain the meaning of a graph, picture, mathematical expression or statement that has been determined                       | Students can explain the meaning of a graph, picture, mathematical expression or predetermined statement.   |

To determine the learning independence of student, observation of student learning independence by observing during learning using instruments such as table 2 below:

Table 2: Instruments for observing student learning independence

| No. | Indicators   | Criteria |        |
|-----|--|----------|--------|
|     |  | high     | medium |
| 1   | plan and choose your own learning activities                     |          | low    |
| 2   | take the initiative and encourage yourself to learn continuously |          |        |
| 3   | responsible for learning   |          |        |
| 4   | learning critically, logically, and full of openness             |          |        |
| 5   | study with confidence  |          |        |

### III. RESULTS AND DISCUSSION

The results of the study are presented according to predetermined mathematical

communication indicators, in general mathematical communication of students in algebra subjects in the function material in the learning environment of blended learning is still lacking for students from high school majoring in social studies and students from vocational high schools, for students who come from Science high school is good.

The following is presented mathematical communication skills for each mathematical communication indicator and examples of student writing in mathematical communication.

#### Indicator 1

In solving problems found students do not write down the problem and what will be solved, this can be known from the shortcomings of students not writing what is known and asked. Thus students do not know the purpose of the problem to be solved. To find out why students did not write down what was known and what was asked, from the results of the interview it was obtained that this information was commonly done since in school in solving problems directly to the solution.

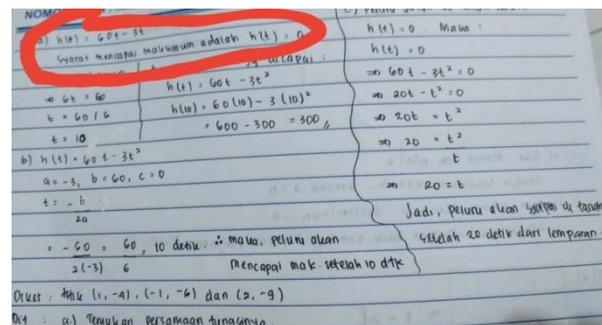


Figure 1: Student do not write down what is know and asked.

From this picture, information was obtained that the students did not know what was known and asked about the problem. Thus students can not describe the direction and purpose of the problem into a form of mathematical statements. Students have difficulty in completing in accordance with the order problems.

Based on these findings, interviews were then conducted to find out why students did not write down what was known and asked. The answers given by some students, this is usually done since in high school in solving problems directly to the answers and not corrected by the teacher.

#### Indicator 2

To solve a problem students must know what formula or formula was used, or a sketch to illustrate the problem. Students do not experience problems in determining the formula that will be used to solve problems and sketch a picture of a problem. In making a sketch of a problem, students generally do not experience difficulties. For example, in sketching a block drawing it has been made well, but there are students who cannot write the beam volume formula

correctly. There are still subjects who cannot connect the measured length and width ratio that is the length of the rectangle twice its width.

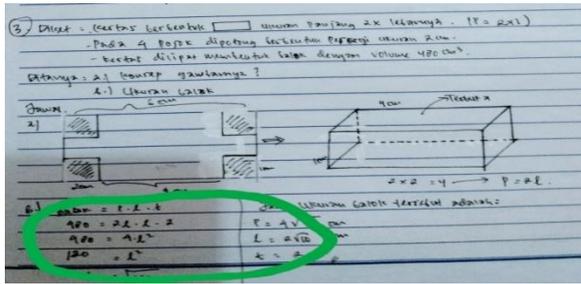


Figure 2: Student mistake in writing formulas

From figure 2, information was obtained that the student was able to sketch a beam from a sheet of paper with the specified size, but in writing the beam volume formula did not match the known size. Student mistakes in writing formulas, resulting in fatal mistakes in determining the desired answer. From the results of interviews with several students who made the same mistake, information was obtained that students knew the formula or formula used, but did not know the relationship between the known size and size after manipulation of the shape of the flat shape into a geometrical shape.

Indicator 3

In using symbols, ideas, structure and mathematical sentences of everyday problems all subjects do not experience difficulties. But in completing the solution is not in accordance with the appropriate strategy.

Students solve problems that are not in accordance with the concepts in accordance with the basic concepts being studied. Students use concepts that are already known when in high school.

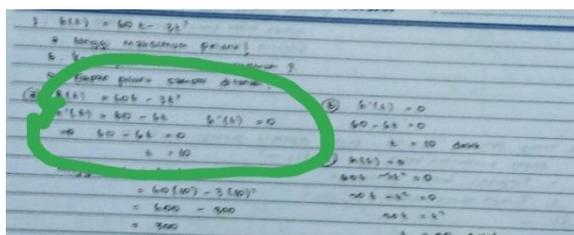


Figure 3. Student mistake writing using the formula.

From this writing, students in solving algebraic problems use the concept of calculus in the derived function to determine the value of t for h (t) which is a quadratic function, should use the concept of determining the peak of a parabola with the formula  $t = \frac{-b}{2a}$  and the maximum height h (t) is  $h(\frac{-b}{2a})$ .

Besides students in solving problems using only one way of solving, no solution is found using another way to solve according to the concept of algebra. For example, in problem 3, solving the

three-variable linear equation system by eliminating and substituting, whereas there are other ways to use the matrix or determinant concept that has been studied previously. In this case student creativity in completing is still lacking.

In addition, students' skills in painting quadratic function graphs and providing graphic properties are lacking.

Indicator 4

To solve a problem, we need a formula or formulas with mathematical symbols that are appropriate to the problem and appropriate steps to get a solution. The subject must be able to connect the formulas accordingly so that the solution is more effective. All subjects are able to choose and use appropriate symbols, mathematical ideas in the form of mathematical sentences to solve everyday problems.

Indicator 5

Everyday problems can be solved with the help of mathematics, problems are manipulated in the form of graphs, pictures and mathematical expressions using symbols, mathematical ideas that are appropriate so that problems are easy to solve.

There are still subjects who cannot change everyday problems into picture shapes and can make pictures but cannot make appropriate mathematical expressions.

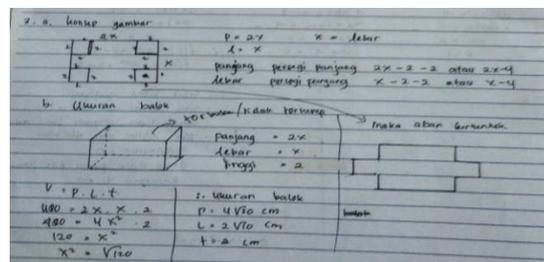


Figure 4: Student writing in manipulating flat plane images into building blocks of images.

The picture above is one of the writings of students who are unable to express everyday problems in the form of mathematics so that they are easily solved. Students can already change the problem of the size of the rectangle into the size of the beam, but students can not show the beam volume formula correctly according to the known rectangle size.

From observations during learning with blended learning student learning independence is not maximized, students are still lacking confidence, this can be noticed when given the task to display the results of work not directly carried out, but must be forced. Inissiative student's effectiveness in learning is still lacking, this can be seen from the work of many students whose twin answers, meaning students are not critical, think logically and cannot choose their own

learning activities.

#### IV. CONCLUSION

Learning independence is very necessary in learning in a blended learning environment. Through blended learning, mathematical communication can be built through assignment and discussion activities both online and offline. Student communication skills can be analyzed using mathematical communication indicators. A good mathematical communication is the ability to use mathematical symbols that are used to form a formula. Mathematical communication skills that need to be developed are: (1) the ability to plan an action in terms of writing what is known and what is asked; (2) the ability to use formulas in accordance with the study of material; (3) the ability to manipulate problems into the form of images, graphics or algebraic formulas; (4) the ability to determine the right settlement strategy for each problem.

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