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The ability of mathematical communication

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I. Introduction

Communication, in general, can be interpreted as a way to convey a message from the messenger to the recipient of the message to tell, opinion, or behavior either directly orally, or indirectly through the media. In the communication must be considered how to make a message that someone can be understood by others. To develop the ability to communicate, people can convey with different languages including mathematical language.

While the ability of mathematical communication can be interpreted as a student's ability in conveying something he knows through the events of dialogue or interrelationships that occur in the classroom environment, where there is a transfer of messages. The transferred message contains the mathematics material that the student is learning, for example in the form of concepts, formulas, or problem solving strategies. Parties involved in communication events in the classroom are teachers and students. The way the message can be transmitted can be spoken or written.

In the process of learning mathematics in the classroom, communication of mathematical ideas can take place between teacher and student, between books with students, and between students and students. According to Hiebert every time we communicate mathematical ideas, we must present the idea in a certain way. This is very important because otherwise, the communication will not be effective. The idea should be tailored to the abilities of the person we are communicating with. We must be able to adjust to the representational systems they can use. Without it, communication will only go from one direction and not reach the goal.

II. Discussion

Mathematics is a language that represents a set of meanings of the statement to be conveyed. According to Fathoni mathematics is seen as a language because "in mathematics, there is a collection of symbols and words (both words in symbolic form)". For example ">" which symbolizes the word "bigger", as well as the word being adopted from ordinary languages, such as the word "function" which in mathematics declares a relationship to a particular rule between the elements in two sets. The new "artificial" mathematical symbols have to mean after a meaning has been given to them. Without it, then mathematics is just a collection of symbols and dry formulas of meaning. In connection with this, we often encounter in life, many people say that X, Y, Z it has absolutely no meaning.

When a concept of mathematical information is given by a teacher to learners or learners get it themselves through the reading, then when there is a transformation of mathematical information from the communicator to the communicant. The response given by the communicant is the interpretation of the communicant about the information. In mathematics, the quality of interpretation and response is often a special problem. This is as a result of the characteristics of mathematics itself laden with terms and symbols. Therefore, the ability to communicate in mathematics becomes a special demand. The ability to communicate in mathematics is an ability that can include and contain various opportunities to communicate in the form of:

1. reflect real objects, images, or mathematical ideas;
2. model situations or problems using oral, written, concrete, graphics, and algebraic methods;
3. use reading, writing, and reviewing skills, to interpret and evaluate mathematical ideas, symbols, terms, and information;
4. responds to a statement or problem in the form of a convincing argument.

Mathematics is generally identical with the calculation of numbers and formulas, so it appears that communication skills cannot be built on learning mathematics. This assumption is, of course, imprecise, because according to Greenes and Schulman, mathematical communication has a role:

1. the central power for students in formulating mathematical concepts and strategies;

2. the success capital for students of approach and completion in the exploration and investigation of mathematics;
3. a container for students in communicating with their friends to obtain information, share thoughts and discoveries, brainstorm, assess and sharpen ideas to convince others.

The ability to communicate is one of the conditions that play an important role as it helps in the process of composing the mind, connecting ideas with other ideas so as to fill in the lack of things in the whole network of student ideas. Correspondingly, Lindquist (in Fitrie, 2002: 16) states that we need communication in mathematics if we want to achieve full social goals, such as mathematical literacy, lifelong learning, and math for everyone.

Even building a mathematical communication according to National Center Teaching Mathematics (NCTM) provides benefits to students in the form of:

1. Modeling situations with oral, written, drawing, graphics, and algebraically.
2. Reflecting and clarifying in thinking about mathematical ideas in various situations.
3. Develop an understanding of mathematical ideas including the role of definitions in mathematics.
4. Using reading, listening, and writing skills to interpret and evaluate mathematical ideas.
5. Assess mathematical ideas through conjecture and convincing reasons.
6. Understanding the value of the notation and the role of mathematics in the development of mathematical ideas.

Teacher activities that can develop students' mathematical communication skills include:

1. Listen and see attentively the students' ideas
2. Investigate the questions and tasks assigned, attract the heart, and challenge the students to think
3. Ask students to respond and assess their ideas orally and in writing
4. Assess the depth of understanding or ideas that students expressed in the discussion
5. Deciding when and how to present mathematical notations in the mathematics language of the students
6. Monitor student participation in discussions, decide when and how to motivate each student to participate (see steps 3 and 4: memory development and starring).

While the indicator of students' ability in mathematical communication on learning mathematics according to NCTM (1989: 214) can be seen from:

1. The ability to express mathematical ideas through oral, written, and demonstrating them and visualizing them visually;
2. Ability to understand, interpret, and evaluate Mathematical ideas both orally and in other visual forms;
3. Ability to use terms, mathematical notations and structures to present ideas, describe relationships and situational models.

Within (1992) states that communication skills become important when a discussion between students is done, where students are expected to be able to express, explain, describe, hear, ask and cooperate so as to bring students to a deep understanding of mathematics. Children given the opportunity to work in groups in collecting and presenting data, they showed good progress as they listened to one another's ideas, discussed them together and then drew up the conclusions that the group had in mind. Apparently, they learn most from communicating and constructing their own knowledge.

Meanwhile, according to Sumarmo (2003) mathematical communication includes the ability of students:

1. connecting real objects, images, and diagrams into mathematical ideas;
2. describing ideas, situations, and mathematical relations both orally and in writing with real objects, drawings, graphs, and algebra;
3. declare everyday events in language or mathematical symbols;
4. listening, discussing, and writing about mathematics;
5. reading with written comprehension or written presentation;
6. making conjectures, formulating arguments, formulating definitions and generalizations;
7. explain and make a question about mathematics that has been studied.

In general, mathematics within the scope of communication includes writing skills, reading, discussing and assessing, and discourse. Without communication in mathematics, we will have little information, data, and facts about students' understanding of the processes and applications of mathematics. Shadiq (2004) "Mathematics is a very powerful, meticulous and not confusing communication tool". For example, 40 x 4 notation can be used to express things, such as:

- Motorcycle mileage for 4 hours with speed 40 km/hour.
- The surface area of the pond with a length of 40 meters and a width of 4 meters
- Many wheels on 40 cars

The above example has shown that 40 x 4 notation can express a different thing.

2.1. Communication Indicators:

There are several indicators that indicate the existence of communication expressed by TIM PPPG Mathematics (Romadhina: 2007):

1. Present mathematical statements orally, in writing, drawings and diagrams
2. Making conjectures (conjectures)
3. Doing math manipulation
4. Drawing conclusions, compiling evidence, giving reasons or evidence for some solutions
5. Drawing conclusions from the statement
6. Check the validity of an argument
7. Find the pattern or nature of mathematical phenomena to make generalizations.

In this paper, indicators of mathematical communication are:

1. Reading the mathematical discourse with understanding means knowing what is known and asked from the given problem.
2. Developing language and mathematical symbols mean being able to express through oral, written, and visually depicting and reflecting images, diagrams into mathematical ideas.
3. Formulating and solving problems means being able to use terms, notations, and mathematical structures to present ideas so as to make the pattern with mathematical models.

III. Conclusion

From the above discussion, it can be concluded that students' mathematical communication skills can be built by:

1. Provide an opportunity for students to pour ideas, thoughts out of a problem into the form of drawings, example as well as in terms of conditions
2. Train students to connect math problems in everyday life
3. Using mathematical language appropriately
4. Building the ability to analyze and evaluate the mathematical thinking and strategies of others.

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