

## **EFFORTS TO IMPROVE STUDENTS' MATHEMATICAL LITERACY IN MATHEMATICS LEARNING**

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### **Abstract**

Mathematical literacy is one of the important skills students need to possess in learning math. Mathematical literacy can be defined as an individual's ability to formulate, use and interpret mathematics in a variety of contexts, including the ability to perform mathematical reasoning and use of concepts, procedures, facts, as a means to describe a phenomenon or event. It could be argued that mathematical literacy can help students understand better the role of mathematics in the real world. But in Indonesia, there are still many who do not know the mathematical literacy. So it is not wrong that to date mathematical literacy of students in Indonesia is still low, this can be seen in three International Study, namely, PIRLS, PISA, and TIMSS. To improve mathematical literacy, learning models are needed that can improve mathematical literacy .

Keywords : mathematical literacy

## **INTRODUCTION**

### **A. Background**

We often apply mathematical concepts in everyday life, even though we do not realize it. Even the development of science and technology today can not be separated also from elements of mathematics. This fact causes mathematics become one of the most important subjects to be given to students starting from elementary level up to college.

NCTM (2000 ) formulated mathematical goals taught to students so that they have the ability to:

- 1 ) Communicate ( mathematical communication);
- 2 ) Reasoning ( mathematical reasoning);
- 3 ) Solve the problem ( mathematical problem solving );
- 4 ) Learn to link the ideas ( mathematical connections ) ; and
- 5 ) Establish a positive attitude towards mathematics ( positive attitudes toward mathematics ) .

The goals stated in the NCTM mathematics can also be a reference for Indonesian government in formulating mathematical objectives given to students just as stipulated in Permendiknas Nomor 22 Tahun 2006, namely :

- 1 ) Learners can understand mathematical concepts .
- 2 ) Learners can use mathematical reasoning both in pattern or nature.
- 3 ) Learners may have the ability to solve problems .
- 4 ) Learners can communicate mathematical ideas using symbols, tables, diagrams or other media to clarify the situations or problems.
- 5 ) Learners have respect towards mathematics.

It can be seen that, based on the mathematical goals, the Indonesian government seeks to develop students' mathematical capabilities consisting of the ability to understand, reason, communicate, connect, solve mathematical problems and develop positive attitude towards

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mathematics. These mathematical abilities are then summarized into one unification packed in mathematical literacy. This is in line with what Niss has stated (Kusuma, 2010), that mathematical literacy consists of five basic skills: 1) mathematical reasoning and thinking, 2) mathematical arguments, 3) mathematical communication, 4) modeling, 5) submitting and troubleshooting, 6) representation 7) symbol and 8) media and technology.

Organisation for Economic Co-operation and Development (Kusuma, 2010) defines that mathematical literacy is the ability to recognize and understand the role of mathematics in real life, provide an assessment and consideration appropriately, utilize mathematics to meet one's needs in order to be a constructive member of society that is full of care and willing to think.

In the meantime, PPPPTK (Pusat pengembangan dan Pemberdayaan Pendidik dan Tenaga Kependidikan Matematika or the Center of Development and Empowerment of Mathematics Educators and Educational Personnel) (2011) defines mathematical literacy as a person's ability to formulate, implement, and interpret mathematics in a variety of contexts, including the ability to perform mathematical reasoning and concepts, procedures, and facts to illustrate, explain or predict phenomena or events.

These mathematical literacy skills often appear in the test items such as PISA International scale (Programme for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study). Indonesia has attended these events for several times, but the results are still unsatisfying. Indonesia was the first to be involved in PISA in 2000, 2003, 2006 and 2009. According to Research and Development (2011), that in 2000 Indonesia stayed at number 39 out of 41 countries in mathematics and science, and in 2003 it ranked 38 out of 40 countries, in 2006 it finished at number 50 of 57 countries and in 2009 it was ranked 61 out of 65 countries. Based on the results of the study, it can be seen that the Indonesian students' mathematical literacy is still very low.

Maryanti (2012) explains that literacy problems are divided into 6 levels with three groups of questions. Literacy question test level 1 and 2 is a group of bottom scale. Literacy test level 3 and 4 is a group of the medium scale, while literacy test level 5 and 6 is a group of high scale. Based on data from OECD (Maryanti, 2012), that in any mathematical content tested in PISA study, the average Indonesian students ranked at the second level and below. Indonesian students still have difficulty in solving literacy test at level 3 up to level 6.

Based on the fact that Indonesian students still have difficulties in solving the literacy test skills of level 3 – 6, so it is better if mathematical literacy is introduced to students starting from elementary school started from level 1 and 2; so that Indonesian students will be familiar with facing literacy test at the higher level. Thus, in the long term Indonesian students will be able to stay at the same level with students of other developing countries.

The mathematical literacy skills the students have is very important, because by having these skills, the students can use the role of mathematics in solving problems that always emerge in everyday life. Increasing mathematical literacy would require the cooperation of various parties. One effort that can be done is by selecting a model of learning that can improve mathematical literacy. Some research on the mathematical literacy has been done; for example by Maryanti (2012) which concluded that there are significant differences between the conventional classroom learning with classes who receive metacognitive guidance. In the meantime, Sugandi (2013) concluded that the increase of literacy skills done by students who acquire Osborn learning model is better than those who receive conventional settings. Likewise, Aini (2013) concluded that, compared to the conventional setting, the learning with processing skills approach gives a greater contribution to the improvement of students' mathematical literacy skills.

Based on these studies, it can be seen that students' mathematical literacy can be developed by applying the model of learning that can involve students actively, so that learning is not only focused on the teacher alone but also student-centered. Students are given the

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opportunity to do their own exploration in discovering the concepts of mathematics, so that they gain an understanding which can be absorbed in greater depth .

### **B. Problem Formulation**

The problems formulation of this paper are as follows;

- 1 . What are the effects of mathematical literacy for students life?
- 2 . How to develop students' mathematical literacy in the school?

### **C. Objectives**

This paper aims at:

- 1 . Determining the effect of students' mathematical literacy skills for their life.
- 2 . Finding out how to develop students' mathematical literacy in schools .

### **D. Benefits Research**

By writing this article, the authors hope to be able to provide inputs for the readers on the importance of literacy. Inputs which can be obtained are as follows:

- a. Giving information about the influence of mathematical literacy in everyday life .
- b. Informing students at how to develop mathematical literacy .
- c. Providing information for teachers to choose models of learning that can help improve students' mathematical literacy.
- d. For the author, this research can be a reference to conduct further research on the application of mathematical literacy in schools.

## **DISCUSSION**

### **A. Effect of Literacy Ability in Student Life**

#### **A.1 Mathematical Literacy**

Literasi (*literacy*) is derived from the word " literacy " which means the ability to read and write. The ability to read and write is a very important initial ability of the students to learn mathematics. Without this ability, the students will have difficulties in learning the lessons and getting along with their environment. Looking at the fact that literacy is very important to study math, then there comes the mathematical literacy. According to PISA ( OECD, 2009), the definition of mathematical literacy is:

*Mathematical literacy is an individual 's capacity to identify and understand the role mathematical plays in the world, to the make well - founded judgments and to use and engage with mathematics in ways that meet the needs of that individual 's life as a constructive , concerned , and reflective.*

In line with the above opinion, the Organization for Economic Co-operation and Development (Kusuma, 2010) defines that mathematical literacy is the ability to recognize and understand the role that mathematics plays in real life, provide an assessment and consideration appropriately, utilize mathematics that can meet the needs of a person to become a constructive member of society that full of care and willing to think.

De Lange ( 2003) also defines that mathematical literacy is not just limited to the ability of the algorithm, not only limited to the basic mathematical knowledge that enables a member of society to live in a difficult situation and enough with what they need, but also includes mathematical knowledge, methods, and processes that can be utilized in various contexts by means of inspiring and insightful thinking.

PPPPTK (Pusat pengembangan dan Pemberdayaan Pendidik dan Tenaga Kependidikan

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Matematika or the Center of Development and Empowerment of Mathematics Educators and Educational Personnel) (2011) also makes the definition of mathematical literacy as a person's ability to formulate, implement, and interpret mathematics in a variety of contexts, including the ability to perform mathematical reasoning and concepts, procedures, and facts to describe, explain or predict phenomena or events.

Based on the definition of literacy from a variety of opinions on the above, mathematical literacy is the ability to frame questions, formulate, solve and interpret problems in real life. PPPPTK (2011) also argues that there are 6 levels that were measured in the ability of mathematical literacy. Here is the explanation of these sixth level:

1 . Level 1

The ability that is measured at this level is the students' ability to answer questions that cover the general contexts. Students are required to perform real actions following a given stimulus .

2 . Level 2

Students' ability to interpret and recognize situations in contexts that require immediate intervention.

3 . Level 3

Students are required to have the ability to properly implement procedures, including procedures that require decisions in a row.

4 . Level 4

Students' ability to work effectively with the model and the concrete but complex situation.

5 . Level 5

Students are required to work with models for complex situations, identify difficulties that they have and conduct predictions.

6 . Level 6

This is the students' ability to conceptualize, generalize, and utilize information based on investigations and modeling of complex problem situations.

## **A.2 The Importance of Mathematical Literacy for Students**

Based on the definition of mathematical literacy that has been described above, it can be said that mathematical literacy is essential for students and also for everyone to face the advancement of science and increasingly rapid technological development. This is in line with Kusuma (2010) who argued that the students' literacy skills train them to have the ability to associate mathematical ideas or problems emerging in this modern age. Mathematical literacy also provides many benefits for the students to practice problem-solving skills which begins from the ability to solve problems in school and later these skills can also be applied in everyday life. Besides, by having good mathematical literacy, students also can have the ability to communicate which is indispensable in presenting the results of the problem solving. By having good literacy skills, students will also be able to provide an assessment and expressed appreciation for mathematics.

## **B. Applying Mathematical Literacy Ability in Schools**

Given that literacy is very important to be possessed by everyone, so it will be better if literacy is introduced since from elementary school. By doing so, the students become familiar with issues related to mathematical literacy. Teachers should also be given training on mathematical literacy skills as well as learning about the model or approach that can create an interesting and fun learning environment for students.

Teachers provide opportunities for students to explore the material to be studied, then the students are guided to actively carry out the construction and develop the knowledge they have acquired. In teaching mathematics in the classroom, the teacher not only teach students to work on the problems correctly but also provide an explanation on the relevance of mathematics

learning for increasing the students' interests of studying mathematics in solving problems that often emerge in real life.

As for some models or approaches that can enhance mathematical literacy learning, are as follows :

1 . Study conducted by Maryanti (2012) found that the approach of Metacognitive Guidance contribute much to mathematical literacy. This approach trains students to have the metacognitive skills. Students are trained to be aware of and take responsibility for their own knowledge and ideas. Differences way of viewing the problem presented is likely to emerge. It is expected that students will have better skill of reasoning because they are not just memorizing the solution of a problem, but they also interpret the problem and seek a solution through the mindset and the knowledge that they have been receiving previously.

2 . Study conducted by Aini ( 2013) explained that, compared with conventional learning, the process of learning the skills approaches provides a greater contribution to the improvement of students' mathematical literacy skills. This is because the skills approach is essentially a process of management of teaching and learning activities that focus on engaging students actively and creatively in the process of acquisition of learning outcomes. Aini ( 2013) also explained that this approach is seen as an appropriate approach to the implementation of learning in schools in order to deal with the growth and development of science and technology growing rapidly.

3 . Linuhung ( 2013) suggested that learning by Wankat – Oreovocz problem-solving strategies can also improve mathematical literacy, because it accommodates the needs of motivating students to be active in teaching and training to solve problems related to mathematical literacy .

4 . Sugandi ( 2013) suggested that the learning model which uses Osborn's brainstorming techniques can improve mathematical literacy skills; this is because that, in the brainstorming process, students are required to bring the ideas that suit their capacity and knowledge and psychological insights as well, so that all the opinions can be accommodated and can be used as a map of learning experience together. The issues raised in the brainstorming session enable the students learn the meanings of a problem so that they can describe the problem with their own words. Students can interpret problems and provide arguments to the given problems.

The activities carried out on the model or approach to learning that has been discussed above can be a good influence on students' mathematical literacy. Besides, there are many other learning models and approaches that can enhance students' mathematical literacy.

## **CONCLUSIONS AND RECOMMENDATIONS**

### **A. Conclusion**

#### *1) Effect of mathematical literacy for student life*

This literacy train students to be prepared to face the advancement of science and increasingly rapid technological development, train their ability to associate with the mathematical ideas which emerge in this modern age, train their problem-solving skills that will be encountered, which begins from the ability to solve problems in school and these skill can be also applied in everyday life, train their ability to communicate because communication skills are indispensable in presenting the results of the problem-solving process. By having good literacy skills, students will be able to provide an assessment and express appreciation for mathematics accurately.

#### *2) Developing mathematical literacy of students in the school*

Literacy skills can be applied to elementary school students. This is intended so that they become familiar with issues related to mathematical literacy. Teachers should also be given

training on mathematical literacy skills as well as learning about the model or approach that can create an interesting and fun learning environment for students. Teachers provide opportunities for students to explore the material to be studied, then the students are guided to actively carry out the construction and develop the knowledge they have acquired previously. In teaching mathematics in the classroom, the teacher not only teach so that students can work on the problems correctly. The teacher should also be able to provide an explanation of the relevance of mathematics learning that is able to increase students' interests in solving problems that often arise in real life.

## **B. Advice**

For mathematics teachers who want to try to increase students' mathematical literacy, they can try to use one of the learning models or approaches as outlined above. Low mathematical literacy level in Indonesia is that of 3-6; so, for the teachers who want to try to train students, they can begin to explore the indicators of the mathematical literacy.

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