The analysis of mathematics literacy on PMRI learning with media schoology of junior high school students

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The analysis of mathematics literacy on PMRI learning with media schoology of junior high school students

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Abstract. Indonesia as a developing country in the future will have high competitiveness if its students have high mathematics literacy ability. The current reality from year to year rankings of PISA mathematics literacy Indonesian students are still not good. This research is motivated by the importance and low ability of the mathematics literacy. The purpose of this study is to: (1) analyze the effectiveness of *PMRI* learning with media Schoology, (2) describe the ability of students' mathematics literacy on *PMRI* learning with media Schoology which is reviewed based on seven components of mathematics literacy, namely communication, mathematizing, representation, reasoning, devising strategies, using symbols, and using mathematics tool. The method used in this research is the method of sequential design method mix. Techniques of data collection using observation, interviews, tests, and documentation. Data analysis techniques use proportion test, appellate test, and use descriptive analysis. Based on the data analysis, it can be concluded; (1*) PMRI* learning with media Schoology effectively improve the ability of mathematics literacy because of the achievement of classical completeness, students' mathematics literacy ability in *PMRI* learning with media Schoology is higher than expository learning, and there is increasing ability of mathematics literacy in *PMRI* learning with media Schoology of 30%. (2) Highly capable students attain excellent mathematics literacy skills, can work using broad thinking with appropriate resolution strategies. Students who are capable of achieving good mathematics literacy skills can summarize information, present problem-solving processes, and interpret solutions. low-ability students have reached the level of ability of mathematics literacy good enough that can solve the problem in a simple way.

1. Introduction

Education is a human need throughout life. Without human education, it will be difficult to develop and become retarded. While the quality of education is often used as a barometer of a country's development. Research on the low-yield results of the 2007 TIMSS study and the mathematics literacy skills of Indonesian students show that Indonesian students' achievement in mathematics is still low in the international average score and Indonesian students are weak in solving problems focused on mathematics literacy. Based on the Program for International Student Assessment (PISA) report 2003, Indonesia was ranked 39th out of 40 countries, in 2009 Indonesian students were ranked 61 out of 65 participating countries, in 2012 Indonesian students were ranked 64th out of 65 countries, while in PISA 2015, Indonesia was still ranked 63 out of 70 countries [1].

One of the factors causing low Indonesian student scores is Indonesian students are poorly trained to solve PISA and TIMSS problems whose substance is contextual, demanding reasoning, argumentation, and creativity in solving them. Conditions, as indicated by the above international

study results, are also found in SMP N 15 Semarang. The material of building the cube and beam space is one of the contents of space and literacy that is quite difficult to understand. Based on the results of the initial tests of students SMP N 15 Semarang even semester academic year 2016/2017 showed results that are not optimal. The initial test results are still low, and there are still many unfinished students. One of the factors of low initial test of students is the low ability of students' mathematics literacy. Students are not familiar with math literacy issues and have difficulty using information obtained from problems to find the right solution to the problem.

The ability of mathematics literacy in PISA is one of the three abilities that are important to be developed and must be owned by students. Such abilities include the ability of mathematics literacy, literacy skills, and literacy skills of science [2]. The ability of mathematics literacy is defined as the ability to understand and apply basic knowledge of mathematics in everyday life [3,4].

Based on the definition of mathematics literacy above, there are three main things that become the main idea of the concept of mathematics literacy. They are: (1) the ability to formulate, apply, and interpret mathematics in various contexts; (2) the inclusion of mathematical reasoning and the use of concepts, procedures, facts, and mathematical tools to describe, explain, and predict phenomena; and (3) the benefits of mathematics literacy skills, that is, to help one apply mathematics to everyday life.

The above description illustrates the importance of developing and enhancing the students' mathematics literacy skills. Because armed with the ability of mathematics literacy to help students always think systematically, helping students to understand the rules that make mathematics as a reference in everyday life, and able to apply mathematics to other disciplines and can prepare themselves in the association in modern society [5]. Literacy skills should be viewed as an important part of the mathematics curriculum.

Some aspects of mathematics literacy skills based on [2] are the mathematics processes, the mathematical content, and the context. The focus in this research is the literacy capability based on seven process capabilities in PISA. The ability of the literacy process involves seven important things: communication, mathematizing, representation, reasoning, devising strategies, using symbols, and using mathematics tools.

Based on the observations made by researchers, mathematics learning in the classroom did not explore the students' mathematics literacy skills but only the transfer of knowledge. Problems given to learners are also not much different from examples of teacher explanations so that learners are less creative in solving high-level problems. Classroom learning should provide sufficient opportunities for students to be able to train and develop mathematics literacy skills as an important part of improving student learning outcomes. The ability of mathematics literacy encourages students to discover and develop ways of thinking in communicating mathematics ideas. The ability of mathematics literacy is one of the capabilities that support other competencies. If the student fails to understand literacy skills, then it is very likely he is less understanding of mathematics.

In improving students' mathematics literacy skills, an active learning process is required that provides many opportunities for students to develop their own ideas. One of them is by implementing the learning of *Pendidikan Matematika Realistik Indonesia (PMRI)* adopted from Realistic Mathematics Education (RME) learning. Wijaya stated that *PMRI* learning is one of the learning approaches that emphasize the importance of science [6]. The significance of science is one of the main aspects of the learning process. The learning process will occur if the learning process is meaningful for learners. Science will be meaningful to the learner if the learning process involves realistic problems. According to De Lange [7] *PMRI* should have five characteristics, namely using contextual problems, using models, using student contributions, interactivity, and integrated with other topics. A class is said to use *PMRI* learning when applying these five characteristics in the learning process.

Students' activities in *PMRI* learning are expected to take place optimally when completed with Schoology e-learning. Islamiyah [8] stated that e-learning is a form of information technology applied in the field of education in the form of cyberspace. E-learning is more appropriately aimed at

transforming existing learning processes in schools or colleges into a digital form that is bridged by internet technology. Rahmawati [9] stated that Schoology is a learning media with e-learning system as a liaison between students and teachers in the division of subject tasks online so that learning can be done quickly and practically. Media Schoology can be accessed through the web www.schoology.com [10].

Based on the above description, this study aims to (1) analyze the effectiveness of *PMRI* learning with media Schoology, (2) describe the ability of students' mathematics literacy on *PMRI* learning with media Schoology which is reviewed based on seven components of mathematics literacy, namely communication, mathematizing, representation, reasoning, devising strategies, using symbols, and using mathematics tool.

2. Methods

This study uses a kind of research mixed methods sequential model with the incorporation of quantitative and qualitative methods in sequence [11]. This research was conducted at SMP N 15 Semarang in class VIIIA and VIIIB with the subject matter of Geometry especially the material of surface area and volume of cube and beam. The selected study period is the even semester of the academic year 2016/2017. Quantitative analysis was conducted to analyze the mastery of *PMRI* learning with media Schoology, to analyze the difference of students' mathematics literacy ability in the classroom with PMRI learning with Schoology and classroom learning with expository learning, and to analyze the improvement of mathematics literacy skills in the classroom with *PMRI* learning with media Schoology. Qualitative data analysis was conducted to describe the ability of mathematics literacy in terms of seven components of mathematics literacy. The subjects of qualitative research were selected by 6 students in the experimental class consisting of two students in high, middle and low group. The determination of this subject is based on the initial ability of student mathematics literacy. At the end of the research activities in both classes were given the students' mathematics literacy skills test. The data were processed by homogeneous test, the average equality test, the normality test, the classical exhaustion test, and the comparison test.

Data collection techniques of this combination method by combining quantitative and qualitative. To get quantitative data used quantitative data collection techniques that are scoring the ability of mathematics literacy in the classroom with *PMRI* learning with media Schoology class with expository learning. To obtain qualitative data used qualitative data collection techniques triangulation of sources and triangulation of ways that is by identifying answers to mathematics literacy tests, interviews, observation, and documentation.

3. Result and Discussion

The data used in the analysis are baseline and final data. Initial data is the value of initial ability of mathematics literacy, while final end data is the final ability of mathematics literacy. The data of students' mathematics literacy skills used in this study were from 60 students as research subjects, consisting of 30 students who were given *PMRI* learning with media Schoology (experimental class) and 30 students were given expository learning (control class). From the initial capability data, it is found that both samples come from normal and homogeneous populations or have a capability that is not much different in terms of initial ability of mathematics literacy. This shows that the initial analysis of both samples has the same variance. From the class average equality test, it is found that the average of initial mathematics literacy ability of experimental class students and control class does not differ significantly.

From the preliminary data, it was found that the two samples came from normal and homogeneous populations or had a capability not much different in terms of mathematics literacy skills. This shows that the initial analysis of both samples has the same variance. And the average class equality test shows that the average of initial ability of experimental class students is the same as the average of the students' exposure of the expository class. Based on the analysis of quantitative data obtained.

3.1. Mastery Classical of Ability of Mathematics Literacy in PMRI learning with Media Schoology
Based on the results of the calculation of classical completeness test with the z test obtained the value of zcount = 2,61 > ztable = 1,64 means H1 working hypothesis accepted. Thus it can be concluded that the mastery of classical learning in the classroom with *PMRI* learning with media Schoology meet the criteria of classical completeness of 75% or more students achieve the ability of mathematics literacy score more than or equal to 70.

3.2. Differences in the Ability of Mathematics Literacy in PMRI learning with Media Schoology and Expository Learning
To find out whether the learning of *PMRI* with media Schoology is better than expository learning, t-test is used. The number of students in the experimental class is 30 students with an average postest score of 81.30 while the number of students in the expository class is 30 students with an average of 74.20. Based on the results of the calculation of different test average obtained value of t count = 3.25 with degrees of freedom (df) = 58. Testing with a significant level of 5% obtained clearly visible that the value with the hypothesis of work accepted which means the average ability of students' mathematics literacy *PMRI* learning with media Schoology more both from the mathematics literacy ability of expository class students. Based on the mean posttest score, the ability of students ' mathematics literacy on the learning of *PMRI* learning with media Schoology is 81.30; this result is higher than the average of students' mathematics literacy ability in the expository class of 74.20. Thus it can be concluded that the average ability of students' mathematics literacy on *PMRI* learning with media Schoology better than learning in expository class.

3.3. Enhancement Ability of Mathematics Literacy
Based on the calculation of gain value obtained experimental class gain of 30% and gain control class by 6%. The increase of mathematics literacy ability is known by doing different test of mean gain value of mathematics literacy ability with t-test. The result of difference test of average gain score between class *PMRI* learning with media Schoology and expository class obtained t_(count)= 3.50. The working hypothesis H1 is accepted if t_(count) ≥ t_(table). The value of t_(table) from the distribution list t with a significant level of 5% and dk = 29 obtained t_(table) = 1.70, so the working hypothesis is accepted. It was concluded that the average ability of students 'mathematics literacy after the *PMRI* learning with media Schoology is higher than the average of students' mathematics literacy skills before the *PMRI* learning with media Schoology activities. To see the average acquisition of the students' mathematics literacy improvement in the *PMRI* learning with media Schoology and the expository classroom learning can be seen in the mean values of the two classes. Based on descriptive statistics, the gain value obtained *PMRI* learning with media Schoology class gain of 30% while the exposure grade gain value is only 6%. When examined from the learning process, the completeness of the students' mathematics literacy ability can be realized due to the learning. This *PMRI* learning with media Schoology has succeeded in improving students' individual ability through student activities. This means that learning by using this learning tool can improve students' mathematics literacy skills because students not only receive information passively from teachers but play a more active role in exploring the information needed in accordance with defined learning objectives. This is consistent with research conducted by [12] that *PMRI* learning with media Schoology can lead to formal student reasoning and can establish informal and formal mathematical representation relationships. This is also in accordance with Wardono's research [13] that learning with a realistic approach can increase the students' literacy skills that PISA refers to.

PMRI learning with media Schoology correlates the informal knowledge of mathematics acquired students from everyday life with the formal concept of mathematics, using Schoology in learning. Students become excited, interested, and bring students more enthusiastic in learning so that learning becomes more meaningful and students become active in learning, not only actively answering but active in using e-learning in learning both in class and after continued outside the classroom, not

limited space and time. Based on the mathematics literacy comparative test, the classroom with *PMRI* learning with media Schoology is better than the expository class. This is because the learning of *PMRI* learning with media Schoology occurs learning involving student activities. Not only learning in the classroom but also the habit of continuous practice questions that are actively and interactively with the media Schoology. In addition, students are active in learning because it uses a contextual problem that makes students think critically and students can construct their own knowledge.

Wallace [14] said that the ability of mathematics literacy in the *PMRI* learning with media Schoology could be improved through learning involving more students and structured, and there is a good reciprocal relationship between teachers and students in learning through Schoology. Improving the ability of mathematics literacy in students with *PMRI* learning with media Schoology showed that the process of *PMRI* learning with media Schoology can facilitate students in the process of mathematization, namely the formulation of real-world problems into mathematical problems so that can be solved as a mathematical problem then the solution is interpreted to be able to provide answers to the problem real world. The process of mathematization is fundamental to that required in mathematics literacy as expressed by [4] and [15]. This result supports the research that has been done by [13] that learning with realistic approach can increase the ability of students' mathematics literacy based on PISA. The same thing is also seen in a study conducted by [16] Nelindhy that there is significant influence between realistic mathematics education on the ability of mathematics literacy of grade VIII SMP students.

Qualitative analysis describes the ability of students' mathematics literacy based on mathematics literacy ability test result and interview result. Interviews conducted on 6 students categorized in high, medium and low ability were taken by each of 2 students from each category on *PMRI* learning with media Schoology. To get a deeper picture of the results of the research, the initial ability of students' mathematics literacy is grouped into three categories: low, medium, and high. The grouping of students' initial abilities used the rules according to Table 1.

Table 1. Student Ability Initial Grouping Limitations

Group	KLM Initial Value Limit
Low	$x < \bar{x} - SD$
Middle	$\bar{x} - SD \leq x \leq x < \bar{x} + SD$
High	$x > x < \bar{x} + SD$

Students' abilities are analyzed based on student answers on the answer sheet of mathematics literacy. The ability of students is based on the steps written by students in solving the problem of mathematics literacy that is from step 7 process components on PISA, ie communication, mathematising, representation, reasoning and argument, devising strategies for solving problems, using symbolic, and using mathematics tools then categorized accordingly with scores obtained by students in process capability. Below is a table of percentage categories of mathematics literacy ability shown in Table 2.

Table 2. Category of Ability of Mathematics Literacy

Class Interval	Category
80 – 100	Very good
60 - 79,99	Good
40 - 59,99	Pretty Good
20 - 39,99	Not Good
0 - 19,99	Bad

Based on the observation and the results of student work, and interviews of the six research subjects obtained the ability of students' mathematics literacy descriptively as follows. Subjects with high literacy ability are PST01 and PST02. The 7 high-literacy students in grade VIII A, PST01 was

chosen because the subject was the subject with the lowest score of the error. While the subject of PST02 was chosen with the consideration that the subject is the subject of the highest score of error in the category of students with high literacy ability. Both subjects have the same tendency in solving the problem of math literacy skills, both on the matter of the initial test and the final test. The similarity is seen in the length of time the problem work and test results obtained. The subject's ability in high literacy skills stands out in all aspects of mathematics literacy. The ability of mathematizing and devising strategies of subjects in high literacy ability has increased significantly after following the study of *PMRI* learning with media Schoology. This indicates that the understanding of the material delivered through the *PMRI* learning with media Schoology is very good. High-ability students can complete what has been planned. Students write down what is known and what is asked. Student analysis in solving both problems and coherent so easily understood. Students give a reasonable conclusion as well as the language used logically. The strategy used to solve the problem exactly, so that get the right answer in accordance with the context of the problems presented. Students have understood the problem, are able to interpret and manipulate and use mathematical symbols in problem solving well. These results support research conducted by Nelindhy [16] which states that the results of literacy ability tests of highly skilled students master the seven aspects of literacy very well.

Subjects with moderate-capacity skills were PSS03 and PSS04. Of the 16 students with moderate-capacity students in class VIII A, the subject of PSS03 was chosen because the subject was the subject with the lowest error score. The subjects of PSS03 were the subjects who scored highest in the moderate-literacy student's category. While the subject of PSS04 was chosen with the consideration that the subjects were the subjects whose score of error was highest compared with other moderate literacy students. In addition, both PSS03 and PSS04 subjects have good ability to convey ideas or ideas so that both are easy to interview. The ability of literacy-capable subjects is being prominent in the representation aspect. The achievement of the representation aspect indicates that the literacy-capable subject is capable of interpreting, translating, and using concrete formulas or objects to photograph the problem properly. The ability of literacy-enhanced subjects is increasing in presenting and interpreting the problem-solving process. The increase of literacy-capable subjects is quite significant when compared to the increased ability of subjects with high literacy. The results are consistent with research conducted by Rahmawati [9] which states that Schoology is very influential on student learning outcomes and research conducted by Wardono [13] that the understanding of the material by students who have moderate literacy through PMRI learning have a good effect on literacy ability. literacy-capable students are able to solve the problem. Students can summarize information, present problem-solving processes, and interpret solutions. Student analysis in solving the problem is quite coherent so that it can be understood. The strategy to solve the problem is precise enough to get the answer that is quite appropriate in accordance with the context of the problems presented.

Table 3. Achievement of student mathematics literacy ability

Mathematics Literacy Capability Indicator	Students of high ability	Students of middle ability	Students of low ability
Communication	Very capable of reading, coding, interpreting possible statements to model.	Very capable of reading, coding, interpreting possible statements to model.	Very capable of reading, coding, interpreting statements that enable forming models ..
Mathematising	Very capable of using an understanding of context to guide or accelerate the process of solving mathematical problems.	Able to use an understanding of the context to guide or accelerate the process of solving mathematical problems.	Be able to use an understanding of context to guide or accelerate the process of solving math problems
Representation	Very capable of making mathematical representations of real-world problems	Very capable of making mathematical representations of real-world problems	Very capable of making mathematical representations of real-world problems
Reasoning and Argument	Very able to explain or justify the processes and procedures used to determine mathematical solutions	Simply able to explain or justify the processes and procedures used to determine the mathematical solution.	Very able to explain or justify the processes and procedures used to determine mathematical solutions.
Devising Strategies	Highly capable of activating effective and sustainable control mechanisms throughout multi-step procedures leading to mathematical solutions and conclusions.	Highly capable of activating effective and sustainable control mechanisms throughout multi-step procedures leading to mathematical solutions and conclusions	Able to activate effective and sustainable control mechanisms throughout multi-step procedures leading to mathematical solutions and conclusions
Using Symbolic	Very able to understand the relationship between the problem context and the representation of the mathematical solution, using that understanding to help interpret the solution in the context of the problem	Very able to understand the relationship between the problem context and the representation of the mathematical solution, using that understanding to help interpret the solution in the context of the problem.	Able to understand the relationship between the problem context and the representation of a mathematical solution, using that understanding to help interpret the solution in the context of the problem.
Using Mathematics tools	Able to use mathematical tools that help to math solutions.	Able to use mathematical tools that help to math solutions.	Able to use mathematical tools that help to math solutions.

Subjects with Low literacy ability are PSR05 and PSR06 of the 7 students with Low literacy skills in class VIII A, the subjects PSR05 and PSR06 were chosen with the consideration that the subjects obtained the highest and lowest error scores. Students with Low Ability on *PMRI* learning with media Schoology have representation ability in very good category; communication get very good category, mathematizing get enough category, reasoning, and argument, devising strategies for solving problems, using symbolic, and using mathematics tools get good category.

This shows that in the learning of *PMRI* learning with media Schoology on low-ability students less able to understand the problem maximally. The strategy used is not appropriate so that the existing problems cannot be solved properly. Students should be more accustomed to understanding the concepts given and can provide reasons for the context of the problem. Students can summarize information. Student steps to solve the problem is quite appropriate but less able to answer the problem. The answer produced by the student is less appropriate to the context of the problem. Students are less able to understand the problem and less able to interpret well. The strategy to solve the problem is quite simple and less profound to get the answer that has not been maximized.

From the result of the research, it can be concluded that with the development of *PMRI* learning with media Schoology can improve students' mathematics literacy ability of the researcher choice in SMP N 15 Semarang. The ability of students' mathematics literacy derived data from mathematics literacy ability test scores. Aspects of basic mathematics skills measured include communication, mathematizing, representation, reasoning and argument, devising strategies for solving problems, using symbolic, and using mathematics tools. Table 3 is a description of the students' mathematics literacy abilities of 6 selected subjects.

4. Conclusion

Based on the above analysis and discussion, the conclusions in this research are (1) The learning of *PMRI* learning with media Schoology can effectively improve the ability of mathematics literacy because of the achievement of classical completeness, the students' mathematics literacy ability in the study of *PMRI* learning with media Schoology is higher than the expository learning, and there is an increase in the ability of mathematics literacy on *PMRI* learning with media Schoology by 30%. (2) Based on qualitative analysis after the students get *PMRI* learning with media Schoology can improve students' mathematics literacy ability. Highly skilled students attain excellent mathematics literacy skills, can work with wide-ranging thinking with appropriate resolution strategies. Students who are capable of achieving good math literacy skills can summarize information, present problem-solving processes, and interpret solutions. Low-ability students have reached the level of ability of mathematics literacy is good enough that can solve the problem in a simple way.

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