Improving Students’ Mathematical Literacy Skills Through Mathematical Process Skills Approach
Quasi-Experimental Study on MTs Student

Indrie Noor Aini
Departement of Mathematics Education – Faculty of Teaching and Education
Universitas Singaperbangsa Karawang (UNSIKA)
Karawang – Indonesia
indrienooraini@gmail.com

Abstract - This study was conducted in response to the fact that students are lack of mathematical literacy particularly on their ability to use their mathematical knowledge in everyday life. To address the problem, this research was conducted using mathematical process skills approach. The purpose of this study are: (1) to compare the achievement attained by the students who are taught using mathematical process approach to the students who are taught using conventional learning in terms of the whole student; (2) to compare the improvement on the literacy skills of mathematical achieved by the students who are taught using mathematical process approach to the students who are taught using conventional learning in terms of the whole student; and (3) to assess whether there is any difference on the improvement of mathematical literacy skills of the students who are taught using mathematical process skills approach in terms of the initially mathematical ability (high, medium, and low), and to assess whether there is interaction between the learning (mathematical process skills approach and conventional) and the initial mathematical ability (high, medium, and low) toward the improvement on mathematical literacy. The design of this study is non-equivalent control group by which the samples obtained are eighth grade students in one of the MTs in Kecamatan Lakbok, Kabupaten of Ciamis which were selected purposively. The research instruments include mathematical literacy test and attitude scale questionnaire. Based on the analysis, it was found that: (1) the improvement on mathematical literacy of students who were taught using learning process skills approach is better than those who received conventional learning; (2) the achievement on mathematical literacy of students who were taught using learning process skills approach is better than those who received conventional learning; (3) the improvement on mathematical literacy of students who were taught using learning process skills approach is better than those who received conventional learning based on initial mathematical knowledge (high, medium and low); and (4) Learning using process skills approach significantly contributed to the improvement of students’ mathematical literacy as compared to conventional learning.

Keyword: Mathematical literacy, Mathematical process skills approach

BACKGROUND
Mathematics is one of the disciplines which taught at every level of education, mathematics is expected to contribute in improving the students’ ability, because mathematics is a means of scientific thinking that plays an important role in efforts to develop science and technology in human welfare.

The purpose of learning mathematics at SMP / MTs in Indonesia contained in Standar Isi, if we look closely it appears that the curriculum developed now already noticed the aspects of mathematical literacy development. Mathematical literacy is the ability to formulate, implement and interpret mathematics in various contexts, including the ability to perform reasoning mathematically and using the concepts, procedures and facts to describe, explain or predict events.

A broader sense of mathematical literacy by Kusuma (2010) is that the mathematical literacy contains the ability to construct a set of questions, formulate, solve and interpret problems that are based on the existing context. To be a person who has mathematical literacy, students need to have the whole of this competence although they might be in different degrees.

According to Niss (in Kusumah: 2010), mathematical literacy includes 5 basic capabilities, namely: (1) reasoning and thinking mathematically, (2) mathematical argument, (3) mathematical
communication, (4) modeling, (5) the submission and troubleshooting, (6) the representation, (7) symbol, and (8) media and technology.

The importance of this mathematical literacy has not gotten along with Indonesian’s students achievement in the eyes of the International. Mastering the mathematical literacy is not fully achieved. This is shown by the results of the Program for International Student Assessment (PISA), which measures the ability of 15 year old students in reading literacy, mathematics, and science. In 2009 even Indonesia ranks 61 out of 65 participants. Mathematical literacy in PISA focuses on students’ ability to analyze, reasoning, and delivering ideas effectively, formulate, solve and interpret mathematical problems in a variety of forms and situations.

Although generally the mathematical literacy is low, the level of students’ academic ability in the class were various. It determines how the teacher’s teaching methods influence on students’ abilities. Supposed high-ability students will be able to improve their learning results by using any teaching methods, but the opposite occurred in the low-ability students. Thus, this study will show how the basic students’ mathematical knowledge influences the learning method that will be given to the mathematical literacy.

Implanting mathematical literacy in students in learning process should be supported by a good learning atmosphere. A teacher should be able to create a learning environment that allows students to actively learn how to construct, discover and develop their knowledge. Teaching mathematics is not only collating sequence information, but also needs to review the usefulness and relevance to the student's interests in their lives.

Looking at the problems above, it is necessary to find the methods and learning approach that directs students having the flexibility to solve the problems they face to achieve higher-level thinking aspect. One alternative learning approaches in effort to improve students' mathematical literacy is by learning the process skills approach. Skill process approach is essentially a management of teaching and learning activities that focus on student involvement actively and creatively in the process of acquiring the learning outcomes (Conny, 1985). This Skill Process Approach is seen as an appropriate approach to the implementation of teaching in schools in order to deal with the fast development of science and technology these days. This Skill Process Approach is different from the conventional one, because in learning with the conventional approach, the teachers only give the subject matter focuses on providing concepts, information and facts as much as possible on the students. As a result, students’ learning outcomes is only limited to the aspects of knowledge alone, while the application may not be done yet.

Dimyati (2010) revealed that the Skill Process Approach is intended to develop the abilities possessed by the students. 1) Skill Process Approach provides accurate understanding of the students about the nature of science, 2) Teaching the skills of a process means to give an opportunity for students to work with science, not merely telling or listening to stories, and 3) Using the process skills to teach science, make students learn the process and product knowledge as well.

Based on the description above, it can be concluded that the Skill Process Approach is a learning approach that leads to the development of basic capabilities in the form of mental physical and social to find facts and concepts as well as the development of attitudes and values through a learning process that enables the students to be able to improve certain skill on students, this goes along with the indicators to be achieved in improving students’ mathematical literacy. So through learning by using Skill Process Approach, it is expected to increase students' mathematical literacy.

Based on the background and importance of the issues raised, the issues examined in this study are: (1) Whether the increase of students’ mathematical literacy who receive learning by mathematical skill process approach is better than students who receive conventional learning in terms of basics mathematical knowledge (high, medium, and low) ?, (2) Is there any interaction between learning (mathematical skill process approach and conventional) and the basics mathematical knowledge (high, medium, and low) towards the improvement of mathematical literacy ?.

**PURPOSE OF THE STUDY**

Literacy is the uptake of the English word 'literacy', which means the ability to read and write. In the Cambridge Advanced Learner's Dictionary Literacy is defined as: (1) Able to read and write; (2) Having knowledge of a particular subject, or a particular type of knowledge. The content and the common notion of literacy is absorbed in various fields, such as mathematics, so that the term Mathematical Literacy appeared. Mathematical literacy is the ability of individuals (the individual's capacity) to know and understand the role played by mathematics in real life, to be able to provide an assessment and consideration appropriately, utilizing mathematics to meet the needs of a person being society's constructive, caring, and willing to think (OECD , in Kusumah 2011). PISA transforms mathematical
literacy principles into three components, namely components of content, process and context. The components are described by the Centre for Development and Empowerment of Teachers and Education Personnel (P4TK, 2011) as follows:

1. The Content Component
   In the study of PISA, mathematical literacy component content is defined as content or material or mathematical subjects that is learned in school, that includes changes and linkages, space and form, quantity, and uncertainty data.

2. The process component
   In the PISA mathematical literacy component of the process is defined as things or steps of a person to solve a problem in a particular situation or context by using mathematics as a tool so that the problem can be resolved.

3. The Context Component
   In the study of PISA, mathematical literacy component context is defined as a situation which is reflected in a problem that tested which may consists of a personal context (personal), the context of the work (occupational), social context (social) and the context of science (scientific).

Learning by skill process approach is the learning process that is designed in order the students can find facts, build concepts and theories with scientific skill process and attitudes by their own way. Azhar (Dimyati and Mudjiono, 2010) revealed that students’ skills process are skills for managing results and teaching-learning process which gives the widest possible opportunity to observe, classify, interpret, predict, implementing, planning research and communicate the results. According to Suwardi (2003) mathematical skills learning process is learning activities that involve different types of mathematical skill process in obtaining, processing and applying the learning outcomes.

The purpose of skills development process is that the students are able to discover and develop their own facts and concepts as well as grow and develop attitudes and values required. The Skill Process can be measured in various ways, among others, with practice tests, written tests and oral tests. The skill process can also be evaluated based on the type of skills throughout the process and can measure the whole integrated skill process.

The Skill Process approach is a learning approach that emphasizes the integration actively of new knowledge by using basics knowledge of students before. The new knowledge will be tested how they use it in answering some questions or contextual issues. If the new knowledge successfully answers the problems encountered, then new knowledge will be stored in long term memory. It provides the students experiences that learning is not just memorizing, but also to understand so that they can apply the concepts learned. Skill process approach has basic theory that is rooted in the theory of constructivism. In this constructivism theory students are encouraged to learn actively and creatively so that students are able to construct their own knowledge or a concept.

RESEARCH METHODS

This study is a quasi-experimental research because the selection of the sample is not random, but received a sample of what their circumstances. The study design used is a Non-equivalent Control Group Design (Ruseffendi, 2005: 52). The population in this research is the students of MTs and accessibility of the population are students of MTs in District Lakbok Ciamis regency, West Java province academic year 2012/2013. The sample in this research is conducted by using purposive sampling technique. The sample used in this study is class VIIIA and VIII B of MTs. Al-Amin. The instrument used in this study is a test instrument consisting tests basics knowledge of mathematics and students’ mathematical literacy tests.

RESULTS AND DISCUSSION

Description N-gain and the average standard deviation of the data based on the mathematical literacy learning and PAM category in Table 1.

<table>
<thead>
<tr>
<th>Category</th>
<th>Statistik</th>
<th>N-gain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>KPM</td>
</tr>
<tr>
<td>High</td>
<td></td>
<td>0,68</td>
</tr>
<tr>
<td></td>
<td>Deviation Std</td>
<td>0,05</td>
</tr>
<tr>
<td></td>
<td>Number of Student</td>
<td>11</td>
</tr>
</tbody>
</table>
Based on Table 1 obtained the information that on the three category of PAM student who received the learning using KPM approach got a higher improvement than students who received conventional learning. It can be seen from the average N-gain difference in mathematical literacy of students in each category of PAM, for the category of high PAM difference of 0.33; PAM category was 0.39; and PAM category under 0.20.

Then, if we see the average N-gain among PAM categories, there are also differences in the average increase in mathematical literacy of students who get learning using the approach of KPM and students who received conventional learning. In the group of students who received learning by using KPM approach, between PAM with high category and medium category there is a difference, that is 0.07; between PAM with high category and low is 0.20; and between PAM with medium and a low is 0.13.

While the students who received conventional learning, between high PAM category and medium the difference is 0.13, the category of high PAM and low is 0.07; and the category of medium PAM and low is 0.06. This fact shows that the higher the PAM students have the higher the literacy skills gained. This indicates that there is a relationship between the PAM of the students with their mathematical literacy.

To acknowledge whether there is any difference in mathematical literacy improvement of students getting KPM learning approach (experimental class) and students who received conventional learning (control group) in terms of the basics knowledge of mathematics category (high, medium and low). It is necessary to test the differences in the average score of N-gain, first thing to do is to conduct the prerequisite test of normality and homogeneity of the scores of N-gain in both classes.

1) Normality Test

N-normality test score gain mathematical literacy using the Kolmogoro-Smirnov. A summary of the results are presented in the following table.

<table>
<thead>
<tr>
<th>PAM Category</th>
<th>Class</th>
<th>Statistic</th>
<th>df</th>
<th>Sig.</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>KPM</td>
<td>0.241</td>
<td>11</td>
<td>0.074</td>
<td>Normal Distributed Data</td>
</tr>
<tr>
<td></td>
<td>Conventional</td>
<td>0.178</td>
<td>11</td>
<td>0.200</td>
<td>Normal Distributed Data</td>
</tr>
<tr>
<td>Medium</td>
<td>KPM</td>
<td>0.171</td>
<td>13</td>
<td>0.200</td>
<td>Normal Distributed Data</td>
</tr>
<tr>
<td></td>
<td>Conventional</td>
<td>0.189</td>
<td>13</td>
<td>0.200</td>
<td>Normal Distributed Data</td>
</tr>
<tr>
<td>Low</td>
<td>KPM</td>
<td>0.210</td>
<td>11</td>
<td>0.189</td>
<td>Normal Distributed Data</td>
</tr>
<tr>
<td></td>
<td>Conventional</td>
<td>0.187</td>
<td>11</td>
<td>0.200</td>
<td>Normal Distributed Data</td>
</tr>
</tbody>
</table>

From Table 2 above shows that a score of N-gain students' mathematical literacy classes and class Conventional KPM has the Sig. > A = 0.05 so that H0 is accepted. This indicates that the score data N-gain students’ mathematical literacy classes and class KPM conventional had normal distribution.

2) Homogeneity Test

To test the homogeneity of variance score of N-gain mathematical literacy skills using Levene test with SPSS 16 at significance level $\alpha = 0.05$. The summary of homogeneity test calculations is presented in the following table.

<table>
<thead>
<tr>
<th>PAM Category</th>
<th>Levene Statistic</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>26,501</td>
<td>1</td>
<td>20</td>
<td>0.000</td>
<td>Non Homogenous Varian</td>
</tr>
<tr>
<td>Medium</td>
<td>0.218</td>
<td>1</td>
<td>24</td>
<td>0.645</td>
<td>Homogeneous Varian</td>
</tr>
<tr>
<td>Low</td>
<td>0.823</td>
<td>1</td>
<td>20</td>
<td>0.375</td>
<td>Homogenous Varian</td>
</tr>
</tbody>
</table>
From Table 3 above shows that the score of N-gain students' mathematical literacy with high category has the Sig. less than \( \alpha = 0.05 \), so H0 is rejected. This means that the score of N-gain students' mathematical literacy classes and KPM conventional class with high category is derived from the variance is not homogeneous. While the score of N-gain students' mathematical literacy with medium and low categories have the Sig. greater than \( \alpha = 0.05 \), so H0 is accepted. This means that the score of N-gain students' mathematical literacy classes and class KPM conventional with medium and low categories derived from homogeneous variance.

3) Test Interaction between Learning Process and PAM

To determine whether there is an interaction between the learning (mathematical skill process approach and conventional) and the basics of mathematical ability (high, medium, and low) towards the improvement of students' mathematical literacy proposed the following hypothesis:

Hypothesis testing:
- H0: There is an interaction between the learning (mathematical skill process approach and conventional) and the basics of mathematical ability (high, medium, and low) towards the improvement of students' mathematical literacy
- Ha: There is no interaction between the learning (approach mathematical process skills and conventional) and the beginning of mathematical ability (high, medium, and low) towards the improvement of students' mathematical literacy

To test this hypothesis used two lanes Anova test, with the testing criteria is if the probability value (sig.) is greater than \( \alpha = 0.05 \), the null hypothesis is accepted, and if the probability value (sig.) is less than equal to \( \alpha = 0.05 \), the null hypothesis is rejected.

Before conducting the two lanes Anova test, the normality test and homogeneity test of variance were conducted. The calculation result of normality test, showed that the data of the improvement of students' mathematical literacy based on learning and basics mathematical knowledge category distributed normally. The result of the population variance calculation shows that the variance appeared from the non-homogeneous population. Therefore, to acknowledge whether or not any interaction between the learning process and students’ basics mathematics knowledge categories, two lanes Anova test was conducted. Two Lanes Anova Test Results shown in table 4.4

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>H0</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAM Category</td>
<td>2</td>
<td>0.112</td>
<td>7.263</td>
<td>0.001</td>
<td>Rejected</td>
</tr>
<tr>
<td>Learning</td>
<td>1</td>
<td>1.659</td>
<td>107.958</td>
<td>0.000</td>
<td>Rejected</td>
</tr>
<tr>
<td>PAM Category*Learning (interaction)</td>
<td>2</td>
<td>0.055</td>
<td>3.590</td>
<td>0.33</td>
<td>Accepted</td>
</tr>
</tbody>
</table>

Based on Table 4.4 can be concluded that the factor category students’ basics knowledge of mathematics (PAM) has a significant influence on students' mathematical literacy. This can be seen from the F value obtained with a value of less than 0.001 significance \( \alpha = 0.05 \). Likewise, the learning factor (mathematical skill process approach and conventional) has a significant influence on students' mathematical literacy. This can be seen from the F value is 107.958 and has a significance value is 0.000 \(<\alpha = 0.05\).

From the results of Anova two lanes test in table 4.4 F values was obtained for the interaction is 3.590 with a probability value (sig.) = 0.33. Because the probability value (sig.) Over 0.05 then H0 is accepted. This means there is no interaction between the learning (mathematical skill process approach and conventional) and knowledge of basics mathematics (high, medium and low) towards the improvement of students' mathematical literacy. No interaction diagram can be seen graphically in Figure 1.
Regarding to the differences in the average score of N-gain mathematical literacy of students who get the learning by using KPM approach and students who received conventional learning by category initial mathematical knowledge of students of high, medium and low, respectively 0.10, 0.13, and 0.03, shows that the learning that used KPM approach provides a greater contribution to the improvement of students' mathematical literacy as compared to conventional learning. However, when associated with basics mathematical knowledge of students (high, medium and low), the medium category gave higher contribution to the improvement of students’ mathematical literacy compared to high ability and low ability students. It is obvious that in Figure 1 and the big difference in the average N-gain indicated that the difference in the average N-gain students who received learning by using KPM approach and conventional in the middle ability category was greater than the difference between the average N-gain students who received learning by using KPM approach and conventional learning in the to the high and low ability category.

4) Test Score Mean Difference N-gain based on Learning and Basics Mathematical Knowledge

Based on the results of normality test that has been done previously, it can be concluded that the score of N-gain KPM and conventional classes for all categories has a normal distribution. As for the homogeneity test showed that the scores of N-gain students 'mathematical literacy for the basics mathematical knowledge of medium and low category derived from a homogeneous variants, but for the students' mathematical literacy with high scores category is not derived from a homogeneous variant.

So to prove the existence of differences in students 'mathematical literacy improvement for each category of basics mathematical knowledge of students mathematical independent sample t-test was conducted by assuming equal variance (t test), and assuming unequal variance (t-test').

The hypothesis of the proposed research, namely:

Testing Hypothesis:

There are differences in mathematical literacy improvement of students who had a learning mathematical skill process approach is better than students who received conventional learning mathematical terms seen from basics mathematical knowledge (high, medium and low). The statistical hypothesis is formulated as follows:

H0: There is no difference in the improvement of students’ mathematical literacy who received teaching process with a mathematical skill process approach with students who received conventional learning mathematical seen from basics mathematical knowledge (high, medium and low).

Ha: There a is difference in the improvement of students’ mathematical literacy who received teaching process with a mathematical skill process approach with students who received conventional learning mathematical seen from basics mathematical knowledge (high, medium and low).

Here's the conclusion of the results of the mean difference test scores N-gain at significance level $\alpha = 0.05$. 
Difference Mathematical Literacy Average N-gain Test
Based on PAM and Learning

<table>
<thead>
<tr>
<th>PAM</th>
<th>Learning</th>
<th>Average</th>
<th>t or t’</th>
<th>Sig</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>KPM : Conv</td>
<td>0.68 : 0.35</td>
<td>5.065</td>
<td>0.00</td>
<td>H0 Rejected</td>
</tr>
<tr>
<td>Middle</td>
<td>KPM : Conv</td>
<td>0.61 : 0.22</td>
<td>7.931</td>
<td>0.00</td>
<td>H0 Rejected</td>
</tr>
<tr>
<td>Low</td>
<td>KPM : Conv</td>
<td>0.48 : 0.27</td>
<td>5.883</td>
<td>0.00</td>
<td>H0 Rejected</td>
</tr>
</tbody>
</table>

Based on Table 4.5 can be concluded that for all categories of students' basics mathematical knowledge, the improvement in students’ mathematical literacy who received learning by using KPM is significantly different from students who received conventional learning.

CLOSURE
Based on the data processing, analysis, findings and discussion the following conclusions as follows: (1) The improvement of students who received learning by using mathematical skill approach is better than students who received conventional learning as seen by basics mathematical knowledge (high, medium and low) (2) The learning process that used KPM approach provides a greater contribution to the improvement of students' mathematical literacy as compared to conventional learning. However, when associated with the basics mathematical knowledge of students (high, medium and low), the middle ability students category contributed higher result to the improvement of mathematical literacy if it is compared to the high ability and low ability students category. This is clearly seen from the big difference in the average N-gain indicating that students who received learning by using KPM approach and conventional in the middle ability category that is greater than the difference between the average N-gain students who received learning by using KPM approach and conventional of high and low ability category.

The recommendations from the writer are (1) The learning by using mathematical skill process approach can be used as learning mathematics, particularly to promote literacy mathematical, (2) In learning process, the use of mathematical skill process approach can create a learning climate that allows students the freedom to propose ideas, questions and issues in accordance with aspects of the skills that is developed, so teachers can use the results of research in guiding students' literacy and implement mathematical skill process approach in any mathematical subjects.

DAFTAR PUSTAKA


