Discovery Learning for Mathematical Literacy Ability

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Abstract. The background of this research is students’ mathematical literacy ability which is still less so most students find difficulty in solving mathematical problem in daily life. Learning which tend to be teacher centered not give change to students to develop their own ideas so the students do not master the concept well. Discovery learning is one of learning which train students how to discover mathematical concept and to train students to express their ideas. This study is quasi experimental study which is aimed to find out the enhancement of mathematical literacy ability of eighth grade students with discovery learning. This research used nonequivalent control group design. The population in this research were all students of the eight grade Junior High School in Tana Toraja. This research conclude that mathematics learning with discovery learning method in eight grade students of Junior High School can enhance the ability of mathematical literacy more significant. Discovery learning give change to students to construct their own knowledge so they can understand mathematical problem until its solution.

1. Introduction

In our life, we often face many problems and information which require the ability in reading information, interpreting and analyzing it critically so we are able to utilize the available information. Such ability is known as literacy ability. In 21st century we need an ability to get many kinds of information, we can manage the information for many usage. Human evolution change is effect of literacy thinking[1]. This shows that literacy ability become something important which should be possessed by each individual. According to Holems that someone who is able to survive productively in 21st century is he or she who is able to solve mathematical problem[2]. Similarly as suggested Kusuma that in modern century, everyone need to posse mathematical literacy ability to be used when facing various problems[3]. Hence, education as a place to prepare next generation who are ready to compete in globalization era should develop literate students ability. Government really aware of importance of literacy so today government through Ministry of Education and Culture initiate literacy movement. This movement give new hopes in involving all components of society to participate actively in cultivating literate society culture.

PISA defined literacy ability as individual ability to identify, understand, and interpret mathematics in various context which is constructed by using and involving mathematics in daily life[4]. Mathematical literacy according to Niis is mathematical ability which comprise: (1) thinking and reasoning, (2) argumentation, (3) communication, (4) modelling, (5) problem posing and solving, (6) representation, (7) using language and operation (technical and formal), and (8) using tool and media[5]. Hayat and Yusuf suggested that someone is though to has mathematical literacy level if he or she is able to analyze, give reason and communicate his/her mathematical knowledge and skill.
effectively, and able to solve and interpret mathematical problem in various situations[6]. Comparing between mathematical literacy and the goal of mathematics subject in content standard in accord with Regulation of National Education Minister No.22 of 2006 and the goal of mathematics subject in 2013 Curriculum according to Regulation of National Education Minister No.58 of 2014 show that there is suitability. As suggested by Sri Wardhani and Rumiati who said that the goal of mathematics which will be achieved in Content Standard is mathematical literacy[2].

Bearing in mind that mathematical literacy need to be possessed by student, students from earlier should be trained and demanded to develop their literacy ability. But the reality in field based on survey result done by international institutions such as Program for International Student Assessment (PISA) until the end of 2016 still place Indonesia in low level that is the lowest ten among the countries surveyed [7]. This reality is corroborated by survey result conducted by Mahdiansya and Rahmawati in several cities in Indonesia which also describe that students’ mathematical literacy ability is still low [8]. The result of initial study in one of Junior High School in Tana Toraja revealed that cross-curriculum literacy movement had been promoted along with collaboration with Priority USAID as school partner but it had not gave maximal result. Particularly in mathematical literacy, students find difficulty in solving mathematical problem in daily life. Learning which tend to be teacher centered not give change to students to develop their own ideas so students not master the concept well. Teacher centered learning which not accommodate students ability development in mathematical problem solving, reasoning, connection and communication[9].

Graven and Venkat identify four aspects in teaching mathematical literacy, namely: (1) Context – driven agenda (to explore the context relevant with students need in the present and the future), (2) content and context driven agenda (to explore the context so it can deepening mathematical understanding and mathematics learning, (3) the mainly content- driven agenda (to learn mathematics and then apply it on various context, (4) content agenda (to give second change for students to learn mathematics bases) [10]. Similarly as suggested by Kusuma that mathematical concept, structure and idea are created and used as tool to organize all phenomena in real world to be changed into symbol manipulation[3]. Good mathematical concept mastery can help student to solve the problem[11]. For that, learning should emphasize on students activeness in finding mathematical concepts which later can be used in various daily problems.

One learning model which is believed can enhance students’ mathematical literacy ability is discovery learning. Shadiq suggested that learning with discovery learning demand students to freely collecting data, making hypothesis, trial and error, searching and finding pattern, generalizing and arranging formulation and general form, proving the true or false of that hypothesis[12]. That stage is process ability which is expected to emerged in mathematical literacy. Discovery learning give change to students to construct their own knowledge so they can understand mathematical problem until its solution[13].

2. Research Method
This study is quasi experimental with nonequivalent control group design. Before class is given treatment, pretest is given first both to experiment class and control class to find out students’ initial ability. Then posttest is given to experiment class to find out enhancement of students ability after treatment. Population in this study are all students of eight grade in one Junior High School in Tana Toraja. Sample in this study are two classes which are assigned as control class and experiment class namely class VIII,a and Class VIII.c. Class selection as study sample is done by purposive sampling by taking account that it is impossible to do sample selection randomly and also characteristic of equal or homogenous sample.

This study involve independent variable and dependent variable. Independent variable in this study is model discovery learning whereas dependent variable in this study is mathematical literacy ability of students. Mathematical literacy ability in this study is ability to formulate mathematical situation, to apply mathematical concept and procedure, to interpret and evaluate mathematical result from a problem of daily life.
3. Result and Discussion
Data testing of pretest result is done by Mann-Whitney test to see difference of students’ initial ability before treatment because data is not normal distributed. Testing result showed that there is no significant difference of mathematical literacy ability of students before treatment both in experiment class and control class as presented in Table 1 below.

| Table 1. Test Result of Pretest Data with Mann-Whitney U test |
|---------------------------------------------------------------|
| Pretest data of experiment class and control class          |
| Mann-Whitney U                                           | 298,000 |
| Wilcoxon W                                               | 676,000 |
| Z                                                         | -1,371  |
| Asymp. Sig. (2-tailed)                                    | 0,170   |

Table 1 show that based on pretest data testing with non-parametric testing by using Mann Whitney test, it is obtained that Asymp.Sig (2-tailed) of 0.170 with α = 0.05. It can be concluded that in level of confidence 95%, Asymp.Sig (2-tailed) > α so null hypothesis (H₀) that there is no significant difference between mathematical literacy ability of students in experiment class and control class before treatment is accepted.

Data of test result after treatment in experiment class by using discovery learning model and in control class by using expository learning is presented in Table below:

| Table 2. Posttest Data of experiment class and control class |
|-------------------------------------------------------------|
| Group           | Ideal Score | Mean | Std. Deviation | Min | Max |
| Experiment      | 100         | 59,78 | 18,15         | 33  | 100 |
| Control         | 100         | 33,79 | 8,70          | 10  | 71  |

Table 2 above shows that mean of mathematical literacy ability of students who receive discovery learning method is 59.78 which is higher than mean of mathematical literacy ability of students who receive expository learning, that is 33.79. The maximal score achieved by students in class with discovery learning model is 100 which is also higher from maximal score achieved by students in class with expository learning, that is, 70. Whereas, the minimal score achieved by students in class with discovery learning method is 33 which is also higher from minimal score achieved by students in class with expository learning, that is 10.

To find out whether there is significant difference in enhancement of mathematical literacy ability of students who receive discovery learning method if compared with students who receive expository learning, it can be seen in Table 3.
Table 3. Data of N-Gain Testing Result in control class and experiment class with Mann-Whitney test

|                     | Data of N-Gain in control and experiment |
|---------------------|------------------------------------------|
| Mann-Whitney U      | 114,000                                  |
| Wilcoxon W          | 520,000                                  |
| Z                   | -4.457                                    |
| Asymp. Sig. (2-tailed) | .000                                    |

Table 3 show that asymp. Sig. (2-tailed) is 0.00 in α = 0.05. Based on this, it can be concluded that in level of significance 95%, asymp.Sig. (2-tailed) is obtained which means that null hypothesis (Ho) state that there is no significant different between mathematical literacy ability of students who receive learning with discovery learning model if compared with mathematical literacy ability of students who receive expository is rejected.

The study result above describe that discovery learning method can enhance mathematical literacy significantly. However, that learning model had not been able to give maximal achievement. This can be seen from mean of mathematical literacy ability in experiment class of 59.78 which is still categorized low. This is because of learning habit which had not demand students to try to express their ideas. Students are get used to become information or knowledge recipient and not as initiator. Student also had not fully directed to solve challenging mathematical problems.

Learning with discovery learning method take more time in its implementation process so the right strategy is needed to regulate the ratio of amount of time with curriculum content available. Discovery learning also demand teacher to design learning in a such way so students are stimulated in doing discoveries based on stimulus given.

4. Conclusion
From the study result above, it can be concluded that mathematics learning with discovery learning method in eight grade students of Junior High School can enhance their mathematical literacy ability significantly. However, the level of achievement in mathematical literacy ability is categorized still less. Therefore, learning process require habituation and enough space for students to solve mathematical problem wich they face by their own ideas. Discovery learning is one of method give change to students to construct their own knowledge so they can understand mathematical problem until its solution.

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References
[1] Donald M 1991 *Origins Of The Modern Mind: Three Stages In The Evolution Of Culture And Cognition* (Cambridge MA: Harvard University Press)
[2] Wardhani, Rumiati 2011 *Assessment Instrument of Mathematics Learning Outcome in Junior High School: Learn from PISA dan TIMSS* (PPPPTK MatematikaKemdiknas)
[3] Kusumah, YS 2011 *Mathematical Literacy. National Seminar Prosiding of Mathematics and Science Education, University of Lampung page.1-11* (Lampung: Research Institution of University of Lampung)
[4] OECD 2013 *PISA 2012 Assessment and Analytical Framework: Mathematics, Reading, Science, Problem Solving and Financial Literacy* (Paris: OECD Publishing)
[5] Mufidah L 2015 *Development of Problem Based Mathematics Learning which Emphasize Metacognition to Enhance Mathematical Literacy of Junior High School Students in SPLDN*
Material (UIN Sunan Ampel)

[6] Hayat B, Yusuf S 2010 Benchmark Internasional Mutu Pendidikan (Jakarta: Bumi Aksara)

[7] OECD 2016 PISA 2015 Results in focus (Paris: OECD Publishing)

[8] Mahdiansya, Rahmawati 2014 Mathematical Literacy of Secondary School Students: Analysis of Using International Test Design with Indonesian Context. *Journal of Education and Culture, Vol.20. No.4* (December 2014)

[9] Herman T 2007 Problem Based Learning to Enhance High Order Mathematical Thinking Ability of Junior High School Students. *Journal Educationist. Vol. Volume 1 Number 1*

[10] Bansilal S, Webb L, James A 2015 Teacher Training For Mathematical Literacy: A Case Study Taking The Past Into The Future. *South African Journal of Education, Volume 35, Number 1*

[11] Fathani A H 2016 Development of School Mathematical Literacy in Multiple Intelligences Perspectives. *EduScience volume 4 No.2*

[12] Shadiq F 2009 Mathematics Learning Models in Junior High School. Center of Development and Empowerment for Mathematics Educator and Educator Staff (Yogyakarta)

[13] Yumanto, Herman T 2016 The Influence Of The Application Discovery Learning Towards Upgrading Critical Thinking Mathematically and Self Confidence Of Fifth Grade Primary School Students. *EduHumaniora J. Pendidik. Dasar Kampus Cibiru, vol. 7, no. 2*