The Improvement of Students Mathematical Understanding and Self-Concept through a Discovery Learning Model

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Abstract

One of the competencies which students must possess is a mathematical understanding. Another aspect that supports understanding is self-concept. An effort that can be taken as a solution for improving students' understanding and the self-concept is a model of learning which can lead students to find their concept. This model is often called discovery learning. This study aims to improve students' mathematical understanding and the self-concept through the discovery learning model. In this study, the researcher used quantitative research. The population of this study was all senior high school Ulumuddin students in the 2016/2017 school year. The sample of this study was 40 students in grade 10 who were randomly chosen from two classes. The data in this study were obtained using instruments compiled in the form of questionnaires and tests that were answered by the respondents. The results showed that the improvement of students' mathematical understanding and self-concept who obtained learning with the discovery learning model was better than students who gain learning without using the model of Discovery Learning. However, there was no interaction between the model and the levels of understanding and the self-concept of students.

Keywords: mathematical understanding, self-concept, discovery learning.

Introduction

One of the mathematical competencies that students can get through learning mathematics is understanding. NCTM (2000) said that learning mathematics with understanding could build new knowledge from previous experience and knowledge.

The ability of understanding mathematics is the most important goal in learning. It gives the understanding that the materials taught to the students are not only memorized but also necessary understanding. Understanding can make students better understand the concept and the subject matter. Mathematical understanding is also one of the objectives of each material presented by the teacher because the teacher is the student's guide to achieve the expected concept. A good education is a successful effort to bring learners to the goals to be achieved so that the material presented can be fully understood by students (Hudoyo, 2003).

Mathematics education emphasizes the relevance and appreciation of mathematics so tend to think and act positively one of them self-concept students. Self concept is a way of looking at a person towards him, seeing the shortcomings and advantages he possessed. Desmita (2010) Self concept as an interpretation of experience.

Based on the observation researcher before researching the students of Ulumuddin Lhokseumawe, grade 10a which amounted to 33 people obtained the data of conceptual understanding ability and low self concept students. The low ability of students' concept comprehension can be seen: 1) students who can reiterate a mathematical concept as many as 15 people (45.5%); 2) students who can give an example of a concept as many as 9 people (27.3%); 3) students who can apply the concept in solving problems as much as 9 people (27.3%). While the low self concept of students can be seen from 1) students' views of mathematics is fun math for me gained 10 people (30.3%); 2) the benefits of mathematics that math is very important in my life got 5 people who answered (15%); 3) Ido not like mathematics got 18 people (54,5%).

From the facts above the cause of low understanding and the self concept of students can be expected because the teacher’s teaching pattern is less precise so that students are less interested in learning mathematics. Math for students is a very scary specter. From the data obtained, the cause of the lack of the concept understanding in learning mathematics is the learning method used by teachers is not appropriate. Teachers usually directly discuss the material, without explaining the concept of understanding first. Even some students are trained directly on numeracy skills

The Discovery Learning model can help students to strengthen their concept because they gain trust in working with others. This model can help students to eliminate skepticism because it leads to final and certain truths and will lead students to understand basic concepts and better ideas (Puspendik, 2013).

Based on the description on the background above, the formulation of the problem to be studied in this research is focused in the form of research questions as follows:
Is the improvement of mathematical understanding of students who get learning with discovery learning model better than students who get without discovery learning?
Is the Self-Concept improvement of students who get learning with the discovery learning model better than without discovery learning?

Research Methods

In this study, researchers used quantitative research. Quantitative research includes every kind of research based on percentage, average, chi-square and other statistical calculations (Moleong, 2000).

The study was conducted on students of two classes is control and experiment who had the equal ability with different learning approaches. The first group was given learning with discovery learning approach. The first group was an experimental group, while the second group was a control group that obtained conventional learning. The research was conducted at Ulumuddin senior high school, Lhokseumawe. The population of this study was all senior high school Ulumuddin students in the 2016/2017 school year. The affordable population in this study were all of the class X students who were selected from two classes at random from the affordable population to be used as research samples. Because the study design used the "Non-Equivalent Control Group," the sample determination was performed using the "Random" technique.

The data in this study was obtained by using the instruments compiled in the form of questionnaires and tests answered by respondents in writing. The self-concept in this study focused on three dimensions of self-concept measurement expressed by Calhoun and Acocella (1995), namely: knowledge, expectation, and judgment.

Student self-concept about mathematics is the total score obtained from the respondent's answer that measure: a cognitive aspect that is student's knowledge about its condition, and affective aspect that is student's assessment about herself.

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After obtaining pretest and posttest data, both pretest and posttest tables were created. Afterward, the mean and the standard deviation of pretest and posttest score were calculated. Then, the gain normalized was calculated based on the gain index criteria (Hake, 1999), with formula as follows:

$$\text{Gain normalized } (g) = \frac{skor\ (postes) - skor\ (pretes)}{skor\ (ideal) - skor\ (pretes)}$$

With the criteria of the gain index as in the table below:

Table 1. Normalized Gain Score

Gain Score	Interpretation
$g > 0,7$	High
$0,3 < g \leq 0,7$	Medium
$g \leq 0,3$	Low

Data analysis was done to answer the research questions about the students' self-concept. The initial data is ordinal data converted into interval data according to Al-Rashid (1994), raising data from ordinal scale to be an interval scale is called data transformation. This data transformation was done using Successive Interval Method. In general, the respondents' answers measured by using the Likert scale with the numerical values 1, 2, 3, 4 and 5, each score will have an ordinal measurement level. The numerical value is considered as an object and then through the transformation process is placed into the interval.

To see the difference between students' self-concept of experimental group and control group, statistic test was used to test the mean difference using SPSS 16 program. To see the correlation coefficient between the self-concept and comprehension ability was used Pearson product moment test.

Results and Discussion

The data analyzed in this research were the pretest data of mathematical comprehension and self concept of students both from experimental using discovery learning model and control class using without discovery learning and also N-gain data of mathematical understanding ability and from the self concept of student s' mathematics of both classes. N-gain data were data used to analyze the improvement of mathematical understanding ability and self concept of students' mathematics so that data could be seen from the difference of improvement in both data.

Data processing was done using the Microsoft Office Excel 2007 and also the Software Statistical Package for the Social Science (SPSS) version 16. The data obtained and analyzed in this study were from the score of mathematical comprehension ability test. From these scores were calculated the normalized gain (N-Gain) the ability of mathematical understanding both experiment and control class.

To test the value of pretest normality in this study used Kolmogorov-Smirnov test using the formulation of the normality test hypothesis as follows:

Table 2. Test Result Normality Score Pretest Ability of Students' Mathematical Understanding

Result	Class	***Kolmogorov-Smirnov$_a$***			Summary
		Statistic	***Df***	***Sig.***	
Pretest	Experiment	0,196	21	0,12	H_0 accepted
	Control	0,193	19	0,06	H_0 accepted

Based on Table 2 above, it can be seen that the pretest score of mathematical comprehension ability of the experimental and control class had the sig value which was greater than α = 0.05 that is the experimental class had a value of 0.12 and the control class had a value of 0.06. This means that H0 was accepted or in other words, the experimental data of the experimental and the control class came from the population whose residual value was normally distributed. The normality of data seen from the students' initial ability of the two classes can be presented in:

Improvement of Student Self concept

Normality Test and Homogeneity of N-Gain Self-Concept

Normality and homogeneity test of N-Gain self-Concept of both classes were needed to determine the test which was used in a hypothesis test. The following table is a description table of N-Gain self-Concept data of the experimental and control class. This test is required to indicate any difference in self-improvement or Self-Concept changes of both classes.

Table 3. Description of Improvement Self-Concept N-Gain Score

Class	N	Minimum	Maximum	$\overline{x}$	SD
Experiment	21	0,20	0,67	0,47	0,12
Control	19	-0,02	0,53	0,22	0,14

Based on Table 3, it can be seen that N-Gain increases self-Concept experimental class was better than the control class. It is shown that the control class's average obtained was 0.22, while the experimental class' had 0.47.

The results of the second normality test of n-gain can be seen in Table 4 below:

Table 4. Normality Test Results of N-Gain Self-Concept

Class	N	***Kolmogorov-Smirnov***			Summary
		Statistic	***df***	***Sig.***	
Experiment	21	0,079	21	0.200	H_0 accepted
Control	19	0,120	19	0,200	H_0 accepted

From Table 4 above, it was found that the value of Sig for experiment class is 0,200 and control class is 0,200>> α = 0.05 so that H0 is accepted. It can be concluded that both N-Gain self-Concept data are normally distributed. Next, a homogeneity test was conducted for the prerequisite test of the t-test. The hypothesis formula used is:

H0: both groups of data have a homogeneous variance
H1: both groups of data have non-homogeneous variance

The homogeneity test of N-Gain self-Concept data was calculated by Levene's using SPSS version 16. The test criteria were as follows:

If the value is Sig. (p-value) ≥ α (α = 0,05), then H0 is accepted
If the value is Sig. (p-value) <α (α = 0,05), then H0 is rejected.

The completed calculation results can be seen in the Appendix. The results of the homogeneity test summary are presented in Table 5 below.

Table 5. Homogeneity Test Results of N-Gain Self-Concept Score

	Levene Statistic	**df1**	**df2**	**Sig.**
N-Gain	1,216	1	38	0,277

Based on Table 5 above, it is seen that significant value = 0.277> 0.05 by taking a significant level = 0.05, this means Ho accepted. It can be concluded that the N-Gain self-Concept data of experimental and control class comes from a homogeneous variance.

Table 6. Difference Test Result of the Improvement of N-Gain Self-Concept

Anova			**Mark**	**Summary**
f.	***df***	***Sig.***		
35,197	39	0,000	H_0 rejected	Had difference

Based on Table 6 above, it can be seen that the value Sig. is 0.00 <α = 0.05, it means H0 rejected. This showed that there was an increase in self-Concept between the students who were taught using the Discovery Learning model was better than those who were taught conventionally.

Conclusion

Based on the result findings, it can be concluded that improvement of the mathematical understanding ability of students taught using *Discovery Learning* model was better than those who were taught without Discovery Learning. Moreover, improvement of Se*lf-Concept* of students who learned through *Discovery* was better than those who were taught without discovery learning.

References

Al Rasyid. (1994). *Tekhnik penarikan kesimpulan dan penyusunan skala,* Bandung.Universitas Padjajaran

Calhoun*,* J. *F & Acocella*. (1995). *Psikologi tentang Penyesuaian dan Hubungan Kemanusiaan*. Semarang: IKIP.

Desmita. (2010). *Psikologi Perkembangan Peserta Didik: Panduan Bagi Orang Tua dan Guru dalam Memahami Psikologi Anak Usia SD, SMP, dan SMA.* Bandung: Remaja Rosdakarya.

Hudoyo, Herman. (2003). *Pengembangan Kurikulum dan Pembelajaran Matematika*. JICA: Universitas Negeri Malang.

Hake R.R (1999). *Analyzing Change / Gain Scores*. AREA D American Education Research Association`s Division D. Measurement and Research Methodology.

Moleong, L. J. (2000). *Metodologi Penelitian Kualitatif*. Bandung: Remaja Rosdakarya.

NCTM. (2000). *Prinsiple of action: Ensuring mathemathical success for all.* Reston: nctm.org

Puspendik. (2013)*. Kurikulum Standar Kompetensi Matematika Sekolah Menengah Atas dan Madrasah Aliyah*. Jakarta: Depdiknas.