Mathematical Understanding and Student Self-Efficacy through Quantum Teaching Learning Models in Integral Materials

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Abstract

Mathematical understanding and self-efficacy are things that must be considered in determining the success of student learning. However, based on preliminary studies at SMAN 1 Delima, those are still low. The purpose of this research was to know the significant improvement between mathematical comprehension and student self-efficacy facilitated by Quantum Teaching learning model and to see the correlation between mathematical understanding and student self-efficacy through Quantum Teaching learning model. This research was experimental research with quantitative approach. The study population was all students of class XI of SMAN 1 Delima. The sample of this research was randomly selected consisted of class XI IPA2 as the experimental class and class XI IPA3 as the control class. The instrument of this study was a mathematical understanding test and a student self-efficacy questionnaire that has been validated by three validators and has been tested in class XI IPA4. The results of the validity and reliability analysis of items on mathematical understanding and self-efficacy questionnaires were tested feasible. A t-test was used to find out the improvement of mathematical understanding and self-efficacy of students facilitated learning model Quantum Teaching. While to see the correlation between mathematical understanding and student self-efficacy, product moment Pearson correlation test was used. The study found that the improvement of students' mathematical understanding and self-efficacy facilitated by Quantum Teaching learning model was better than conventional learning. The correlation between mathematical comprehension and student self-efficacy facilitated by Quantum Teaching learning model was in a low category. Therefore, the quantum teaching model can be applied by teachers to improve students' understanding and self-efficacy on integral materials.

Keywords: quantum teaching model, mathematical understanding, self-efficacy.

Introduction

One of the important factors in mathematics learning is students' mathematical understanding ability. NCTM (2000) mentions one vision of mathematics learning that students must have a mathematical understanding in learning mathematics. The importance of mathematical understanding ability is also mandated in the curriculum 2013, which aims to enable students to understand mathematical concepts, to link and to apply concepts flexibly, accurately, efficiently and appropriately in problem solving (Permendikbud, 2016). Therefore, studying mathematics with mathematical understanding is the main thing teachers need to pay attention to. It aims to make students able to solve problems and apply the mathematical understanding in their daily life. This is consistent with what has been stated by Herawati (2010) that in learning mathematics students must understand mathematical concepts in advance to solve real life problems.

Understanding the concept can lead students to have a good mathematical understanding in learning mathematics. The understanding of the concept according to Skemp in Zulkardi (2003) is divided into two: first is instrumental understanding, where this understanding is an understanding to a concept that is not interconnected, and students can only memorize the formula to calculate simple things only; second is a relational understanding in which this understanding includes structures to solve broader scope issues. Handayani (2016) expressed that relational understanding students can understand an idea, fact, or mathematical procedure if it is associated with a network of connection strengths. The indicator of mathematical understanding by Afgani (2011) is the ability to re-state the concepts that have been studied, the ability to classify objects based on whether or not fulfilled the requirements that form the concept, ability to apply the concept algorithm, ability to provide examples and counterexample of the concepts studied, capabilities of presenting concepts in various forms of mathematical representation, capabilities linking the various concepts (internal and external mathematics), and capabilities of developing the necessary conditions and or sufficient conditions of a concept.

Misdalina's Research (2009) and Herawati's research (2010) have shown that mathematical understanding in mathematical learning has not been optimally owned by students. Misdalina (2009) found that students' integral comprehension ability is still low which is caused by the presentation of abstract concepts to concrete in a monotonous way, thus making students bored in learning. The same thing is shown by the results of Herawati (2010) who found that students' mathematical understanding of integral concepts is still low due to the lack opportunity to know the existence of material relation learned with real life. Thus, students' mathematical understanding of integral material needs attention from the teacher. The same thing was also shown by Usman's (2013) study and Shalihah's (2016) study which showed that students' understanding of integral concepts and their use in solving problems was still low, which is caused by the domination of the lecturer in explaining the material and the students are invited to use formulas or properties (theorems) that have been presented.

In addition to a mathematical understanding of students, one of the psychological factors that influence in determining the success of student learning is self-efficacy (Hasibuan, 2016). Bandura & Locke (2003) stated that self-efficacy is a belief that exists in someone's ability to possess a problem. Fajri (2016) concluded from the results of his research that students who have high self-efficacy will give birth to a positive attitude, where the positive attitude can make students following the lesson, being active in learning, trying to complete the task given thoroughly and on time and challenging questions so that the learning objectives can be achieved.

One of the learning models that the author believes can motivate students to improve mathematical understanding with high self-efficacy is learning model Quantum Teaching. Quantum Teaching model can guide students to find out the real benefits of learning, so students do not only imagine a concept but also understand what he learned (A'la, 2012). According to Darkasyi (2014) quantum teaching learning model can help students in understanding the basic concepts of a material.

The steps in the learning model Quantum Teaching has four main characteristics including: (1) democracy element that takes precedence in the teaching-learning process, (2) students feel satisfied in learning, (3) students' stability in mastering the material or skills taught, and (4) the ability of the teacher to present what students found in the form of concepts, theories, and models (DePorter, 2005).

Several stages of learning contained in the Quantum Teaching model are known as TANDUR which stands for growth, experience, name, demonstrate, repeat and celebrate. Stages in the learning model Quantum Teaching can lead students to find and then conclude their concepts so that students can remember those in a long time (DePorter, 2005). Quantum Teaching model requires teachers to be able to look for a material relationship to the real world of students so that students are expected to use the knowledge gained in the application of everyday life. In the integral learning process, after going through the natural stages, students can name the concepts they have acquired and then demonstrate them. So, students will be trained to understand integral concepts in stages and eventually will open their insights into mathematics related to integral material. Therefore, it needs to apply the quantum teaching-learning model to gain conceptual understanding and improve student self-efficacy, especially in learning mathematics.

Research Methods

This research was experimental research with quantitative approach. This study aimed to determine the significant improvement between mathematical understanding and self-efficacy of students facilitated by the learning model of Quantum Teaching and by conventional learning. The conventional learning according to Hamalik (2006) is a learning model that uses a method that just like that with the purpose of the students knowing something is not able to do something and does not need to be adapted to the existing knowledge.

The experimental research design in this study used Pretest-Posttest Control Group Design (Sugiyono, 2013). This study specifies the students of class XI SMAN 1 Delima as research population (there are seven classes in total). Sampling in this research was done by random sampling from all classes of XI. One class was selected as the experimental class and another class as the control class. The experimental class, Class XI IPA2, was applied to Quantum Teaching learning model, while class XI IPA3 as the control class is taught by conventional learning.

The data of students' mathematical comprehension test with quantum teaching approach and conventional learning were analyzed by comparing the pretest and posttest scores. To calculate the mean difference between the experimental class and the control class, the difference of two average using t-test with significant level $\alpha = 0{,}05$ was tested. The questionnaire was used to measure student self-efficacy. To observe the difference of self-efficacy of experimental group and control group, a statistical test used was a performance test of the average difference.

Before the research instrument is used further, the research instrument was consulted to the supervisor. The next step was the instrument validation of some lecturers and teachers, including two lecturers of the Mathematics Education Department, Faculty of Teacher Training and Education of Ar-Raniry University in Banda Aceh, one mathematics lecturer of Mathematics Education Department of Syiah Kuala University, and one Mathematics teacher of SMA Negeri 1 Delima Pidie. After getting input and suggestions from the validators, the researcher made a new improvement before testing it to school. A pilot study was conducted to measure the adequacy of time and readability of the problem. The problem is tested for the validity, reliability, distinguishing power and the level of difficulty to have good quality.

The matrix of mathematical understanding used in this study is given in Table 1.

Table 1. Matrix Problem Mathematical Comprehension Test

No	**An indicator of Achievement Competency**	**An indicator of Mathematical Understanding**	**Question Indicator**
1	Determining the concept of an indefinite integral as a reversal of a functional derivative	The ability to reiterate the concepts studied	Given the question of indefinite integrals, the student can solve an indeterminate integral with an indefinite integral formula
2	Resolving issues related to the indefinite integral (anti-derived) algebraic functions	The ability to develop requirements needs and requirements quite a concept	Given the question of the indefinite integral of algebraic functions, students can solve the indeterminate integral by using integral properties of course
3	Using an integral formula of course to solve problems related to the integral of course	Ability to apply concepts by the algorithm	Given a matter of certain integrals, students can solve a certain integral with a certain integral formula
4	Determining the area of the area above and below the axis x	Ability to link the various concepts	Given the area of the curve with the x axis, students can calculate the area of the curve-bounded region with the x-axis
5	Determining the volume of a rotary object with the x-axis and the y-axis	The ability to present concepts in various forms of mathematical representation	Given a rotary object with the x-axis, the student can calculate the volume of a curved circular object with the x-axis and around the x-axis as far as 3600

Results and Discussion

The results of the mean difference test, Gain-Normalized, increased in students' mathematical understanding can be seen in the summary of the calculation results shown in Table 2.

Table 2. Test Results Mean Differences Score Gain Mathematical Understanding

Class	t-test for Equality of Means			Mean Difference	Std.Error Difference
	t	df	Sig. (1-tailed)		
Experiment	2,742	28	0,2516	0,4280	0,2516
Control		28		0,2326	0,1855

Based on table 2, we get a significance value of 0.009 <0.05. Results t arithmetic is 2.742 and t table 1.6706. Because the value of t arithmetic >t table, it can be concluded that the increase of mathematical understanding of students who gain learning outcome with the application of quantum teaching models was greater than students who obtained learning outcome conventionally. The result of the difference test of the mean score of student self-efficacy can be seen in the summary of calculation result shown in Table 3.

Table 3. Mean Difference Test of Self-efficacy Scores of Quantum Teaching and Conventional Classroom Students

Class	t-test for Equality of Means			Mean Std. Error		Std. Error Difference
	t	df	Sig. (1-tailed)		Difference	
Experiment	10,802	28	0,000	0,25	0,64	0,2516
Control		28		0,10	0,24	0,1855

Based on table 3, the results of the mean test of students' self-efficacy that obtained the model of learning Quantum Teaching and conventional as seen in table 3 above obtained a significant value smaller than $\alpha = 0,05$ of 0,000. Result t count = 10,802 and t critical = 1, 6707. Because t count value > t critical, then Ho rejected, so it can be concluded that the self-efficacy of students in the class that obtained the learning model of quantum teaching was better than the self-efficacy of students obtaining conventional learning. Danaryanti (2014) found that the learning model of Quantum Teaching can improve student learning outcomes, and increased mathematical communication ability compared to students who applied direct learning model. Nurhasanah (2016) also found an interest in learning the mathematics of higher students by using Quantum Teaching learning model that makes students are more active in the classroom. Furthermore, Murizal (2012) found that with the application of Quantum Teaching learning model, students will be able to understand the concept correctly.

The results also showed that improving students 'mathematical understanding facilitated by Quantum Teaching learning model was better than students who facilitated conventional learning and improving students' self-efficacy through Quantum Teaching learning model was better than students who are facilitated by conventional learning. The findings showed that there was a correlation between mathematical understanding and self-efficacy of students facilitated by Quantum Teaching learning model. This can be seen from the value of r > 0 (the direction of the relationship between mathematical understanding and self-efficacy is expressed by positive sign), that explained if a student's mathematical understanding increases, then the student's self-efficacy will also increase.

Conclusion
The conclusion of this research is: there is a significant improvement between students' mathematical understanding facilitated by the Quantum Teaching learning model and students facilitated by conventional learning; there is a significant improvement between students' self-efficacy facilitated by the Quantum Teaching learning model and the students facilitated by conventional learning; and there is a correlation between mathematical understanding with student self-efficacy facilitated by Quantum Teaching learning model, but its relation is categorized low.

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