The Relation between prior knowledge and students' mathematics reflective thinking ability

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The Relation between prior knowledge and students' mathematics reflective thinking ability

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Abstract. The reflective thinking ability is one of the higher order thinking skills (HOTS), and mathematics reflective thinking is one of the abilities needed in learning mathematics. This study aims to reveal the relation between prior knowledge and mathematics reflective thinking ability which studied by quantitative method. Data collection used instruments of mathematics reflective thinking test. Samples in this study were students of class VIII at junior high school. The results showed that there was a positive relation between prior knowledge and students' mathematics reflective thinking ability with the correlation coefficient 0.49. The regression equation shows that each addition of one prior knowledge score was followed by change in increase in students' mathematics reflective thinking ability by 0.5539. It can be concluded that the prerequisite material as a prior knowledge must be thoroughly learned so as to have a large contribution to the success of learning further material.

1. Introduction

The Industrial Revolution 4.0 as a phase of the technological revolution has changed the way in which human activities took place in the scale, scope, complexity, and transformation of previous live experiences. Facing the Industrial Revolution 4.0 is certainly not that ease, so we must prepare ourselves to face it. One important element which must be a concern is preparing a more innovative learning system, and improving the outcomes competence owning 21st century skills; learning and innovations skills.

There are five main domains of 21st century skills namely digital literacy, intensive thinking, effective communication, high productivity and spiritual as well as moral values [1]. Meanwhile, Griffin & Care (2015) classifies 21st century skills and competences as; ways to think (knowledge, critical and creative thinking), ways to learn (literacy and soft skills), and ways to learn with others (personal, social, and civic responsibilities) [2]. The US-based Partnership for 21st Century Skills (P21), identifies critical thinking skills, creative thinking skills, communication skills, and collaboration skills as competencies needed in the 21st century. These competencies are known as 4C competencies [3].

Thinking ability becomes one of the main domains of 21st century skills and is one of the life skills that need to be developed through the educational process. Through thinking ability, someone will be able to comprehend and find solutions to all problems encountered in his/her life. Therefore, in the Industrial Revolution 4.0, thinking skill becomes an essential skill that must be possessed by every graduated students at every level of education. One of the advanced thinking skill level and is

categorized as Higher Order Thinking Skill (HOTS) is reflective thinking ability. "The capacity of human minds and brains in understanding and creating knowledge" [4]. Whereas Paden conveyed that reflective thinking is "An analysis and making judgment about what has happened" [5]. Furthermore, reflective thinking is the process of making meaning that moves from one experience to the next by making deeper understanding of the relationship and connecting experiences or ideas to another [6].

In mathematics learning, reflective mathematical thinking skill is one ability that must always be facilitated in its development. Mathematical reflective thinking skill is needed so that the students can learn to think fast in making appropriate strategies for problem solving. Mathematical reflective thinking skill will go through the stages of reflection in which students will reflect to solve the mathematical problems they are facing. In reflecting, students will use their initial ability, initial ability or prior knowledge is very important as a provision for students to study mathematical material further.

Preliminary studies conducted showed that in some junior high schools, students' reflective thinking ability still tends to be low and their reflective thinking ability has not been facilitated in its development in learning. The writer is interested in studying further related to this mathematical reflective thinking ability. The objective of this research was to examine whether there is a positive relationship between prior mathematical knowledge and mathematical reflective thinking ability of junior high school students.

2. Method

This research was conducted at SMP Negeri 2 Cibinong, The Regency of Bogor, West Java, Indonesia. By using convenience sampling technique, sample consisted of 68 students in the eighth year was obtained. The writer took the eighth year students of junior high school because the junior high school students had already been in elementary school so that they had sufficient prior knowledge to continue higher level of mathematics material. They had also been in the transition period to study mathematics at junior high school level for one year, so it is expected to have sufficient and good mathematical reflective thinking skills.

This was a survey research using correlation technique, where the researchers collect data from prior knowledge test and tests of mathematical reflective thinking skills in form of description tests. The data gained were then analyzed and tested by using Pearson correlation to determine whether there is a relationship between the two variables; the ability of prior knowledge as the independent variable and mathematical reflective ability as the dependent variable [7]. The instrument used was the prior knowledge test and mathematical reflective thinking test which had been validated and tested for reliability. The instrument validation process was done by validating content by several experts and analyzing the results of the instrument's limited trial results, namely item validity using the correlation coefficient between the item's score and the instrument's table score. The validity analysis results showed that all items in the prior knowledge test and the mathematical reflective thinking ability test were valid and reliable.

3. Result and Discussion

3.1. Result

Based on the research, the data were gained from prior knowledge test and mathematical reflective thinking test given to the students of SMPN 2 Cibinong. To make it easier to guess the relationship between the two variables, it is presented in the distribution table of prior knowledge data scores with the reflective mathematical thinking ability in the following table:

Table 1. Score distribution between the two variables

Reflective Thinking		*Prior knowledge*				
Mathematical				Low	Medium	High
26-30	Low	12-17	Low	10	11	0
31-35	Medium	18-22	Medium	9	4	8
36-44	High	23-28	High	5	7	14

From table 1, it can be seen that students with low mathematical reflective thinking skill had low prior knowledge distribution (10 students) and medium (11 students) and no students had high prior knowledge. On the other hand, students with medium reflecti[5] mathematical thinking skills had a various prior knowledge distribution, [5]anging from 9 students with low prior knowledge, 4 students with medium prior knowledge and 8 students with high prior knowledge. Th[5]last was students with high reflective mathematical thinking skill were 1[5]students (the largest) had high prior knowledge, 7 students with medium prior knowledge and only 5 students with low prior knowledge.

Before testing the hypothesis, the writer firstly analyze the data requirements test. Test requirement analysis for the classic assumptions made was the normality test and linearity test. Normality test was done to determine whether the data gained from population were normally distributed or not. Calculation results for normality tests of reflective mathematical thinking ability showed that $L_{counted} < L_{table}$ it was $0.1048 < 0.1074$, so that H_0 was accepted and the data comes from populations were normally distributed. The results of the prior knowledg normality test results indicated that the $L_{counted} < L_{table}$ it was $0.1058 < 0.1074$, so that H_0 was accepted and the data gained from populations were normally distributed.

The next classic assumption test was the linearity test. Linearity test was intended to determine whether two variables are linearly patterned between each other. In other words, the linearity test is administered in order to test the equation model of dependent variable and independent variable. As in this study there was one dependent variable (X) and one independent variable (Y), then the linearity test was the linearity test X against Y. A summary of the results of the calculation of linearity X against Y gained Fcounted 1.30 and Ftable 4.04. Conclusion: because F counted <F table, then the two variables were linearly patterned. In other words, the research data for prior knowledge variables and students' mathematical reflective thinking abilities were linearly patterned.

The research hypothesis proposed was: "There is a positive re[2]ionship between prior mathematical skill and students' reflective mathematical thinking skill". Based on the calculation results of simple regression analysis in the prior knowledge (X) variable with mathematical reflective thinking ability (Y) produces a regression direction of + 0.5539 and a constant of 23.262. Thus, the form of the relationship between the prior knowledge variable with the ability to think mathematically reflective is illustrated by the model or variable regression equation $\hat{Y} = 23.262 + 0.5539X$. In order this regression model to be acceptable to draw research conclusions, it must meet the requirements of significance and regression linearity, the F test was used. The results of the calculation of the significance of the regression test gained a calculated F value of 20.98. The F value of the table at the significance level $\alpha = 0.05$ with the degree of freedom (db) numerator 1 and the degree of freedom (db) of the denominator 66 is 3.99. Because the calculated F value > F table at the significance level $\alpha = 0.05$, the simple regression model $\hat{Y} = 23.262 + 0.5539X$ was stated to be very significant. This finding meant that if prior knowledge increases by 1 unit, the mathematical reflective thinking ability of SMPN 2 Cibinong students tended to increase by 0.5539 at a constant 23.262. In other words the ability of mathematical reflective thinking is also determined by the prior knowledge possessed. The graphs for the linear regression equation can be seen in the figure below:

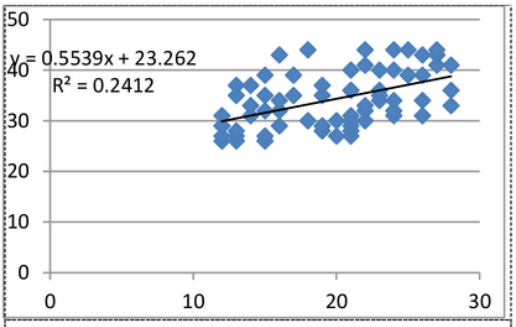

Figure 1. Equation of Linear Regression

The results of the correlation analysis between prior knowledge (X) and the reflective mathematical thinking (Y) gained the coefficient of correlation (ry) of 0.49. The value of the coefficient of thought shows the relationship between prior knowledge and students' mathematical reflective thinking ability was positive and very strong. This finding justifies the research hypothesis which involves a positive relationship between prior knowledge and students' mathematical reflective thinking abilities. In other words, the higher the prior knowledge, the higher the mathematical reflective thinking ability. This relationship is a significant relationship. This is consistent with the results of testing the significance (meaningful) coefficient of knowledge between prior knowledge and mathematical reflective thinking ability through the t-test. The test results on the tcount of 4.56. The value of t table at the significance level $\alpha = 0.05$ with a degree of freedom (db) = 66 is 2.00 because the value of t is 4.56> t table = 2.00 then H0 is rejected. This means accepting H1 which says that the coefficient between prior knowledge and mathematical reflective thinking ability is significant. A positive, strong and significant relationship between prior knowledge (X) and the mathematical reflective thinking ability (Y) of SMPN 2 Cibinong students resulted in a coefficient of determination (ry2) of (0.49) 2 = 0.2412. 24.12% of the variation that occurs in mathematical reflective thinking ability (Y) can be explained by variations of prior knowledge (X) through the regression model $\hat{Y} = 23.262 + 0.5539$ X. In other words, the support that was contributed by the prior knowledge variable to the reflective mathematical thinking ability of SMPN 2 Cibinong students was 24.12%.

3.2. Discussion

Based on data from the analysis results of mathematical reflective thinking ability with prior knowledge that 24.12% of the variation that occurs in reflective mathematical thinking skill can be explained by variations in prior knowledge. This was in line with the data gained in which the students with mathematical reflective thinking skills in the medium category, it turned out that majority came from students with low and high prior knowledge. There were only 4 students came from medium prior knowledge. This means that this reality is in line with research findings that prior knowledge is positively related to students' reflective thinking skill.

Based on the analysis results gained, a regression model between prior knowledge with mathematical reflective thinking skill was $\hat{Y} = 23.262 + 0.5539X$. $\hat{Y}$ (Y with hat) showed that Y obtained from the regression and to distinguish Y from the observations, the coefficient b was the linear regression direction coefficient stating the average change in the variable Y for each change in variable X by one unit. This regression model showed that each increase in one prior knowledge score

will be followed by an increase in the mathematical reflective thinking skill score which was 0.5539 units at a constant 23.262. In other words, the higher the prior knowledge of students is, the higher the achievement of mathematical reflective thinking skill. This means that the influence of prior knowledge on students' mathematical reflective thinking skill is very strong.

Prior knowledge is a mathematical skill and competence owned by students can be used to understand and to solve problems in subsequent mathematical concepts. These skill and competence must have been gotten by students at the previous educational level or in the discussion of previous mathematics topics. Students with high prior knowledge (adequate) will be easy to solve problems on higher mathematical concepts (advanced) so that eventually they can achieve or have reflective mathematical thinking skill as expected and will be easier to learn the next material. Furthermore, because of the reflective thinking, the mistake factor of students in solving problems can be reduced and can encourage students to obtain the best strategy in achieving the learning objectives[8] In choosing a strategy or method of completion, she did it with great care and consideration, and was aware of the consequences of the chosen way [9] Reflective thinking process also by realizing mistake and trying to fix the problem [10]

This is in accordance with the opinion of Dick and Carrey that the initial ability (prior knowledge) is the knowledge and skills that must be possessed by students before he continues to the next level [11]. Thus, students having high prior knowledge, their mathematical reflective thinking ability is getting higher too. This means that there is a positive relationship between the prior knowledge of students with the achievement of mathematical reflective thinking skill. This is in accordance with the research findings showing that the correlation coefficient value between prior knowledge of students and the mathematical reflective thinking skill was 0.2412. This correlation coefficient value means that the relationship between prior knowledge and students' mathematical reflective thinking skill is positive and strong enough. The positivity and strength of this relationship contributed 24.12% to the increase in mathematical reflective thinking abilities. In other words, prior knowledge students contribute 24.12% to the improvement of students' mathematical reflective thinking abilities. So, for that the teacher needs to explore and revive prior knowledge possessed by each student when they will begin the process of learning mathematics, especially on concepts which are prerequisite material from the mathematical material to be learned. One way lecturers can do in tracing student prior knowledge is through pre-tests given before the learning process begins. And, to revive students' memories of mathematical concepts can be done by repeating the mathematical concepts in between learning or provide re-briefing outside of class hours that can be done individually or in groups.

Coclusion

There is a positive relationship between prior knowledge and the mathematical reflective thinking skill of SMPN 2 Cibinong students. This indicated that the higher prior knowledge of the student is, the higher the achievement of mathematical reflective thinking abilities. This is supported by the contribution of mathematical prior knowledge variable to the achievement of students' mathematical reflective thinking skill by 24.12%. It can be concluded that the prerequisite material as a prior knowledge must be thoroughly learned so as to have a large contribution to the success of learning further material.

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