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The Combination of the Quantum Learning Model and the Make-a-Match Method to Improve the Cognitive Ability of Elementary Students in Mathematics

Rusnilawati[a]*, **Zuli Nuraeni**[b], **Dina Ariska**[a], [a]PGSD, Universitas Muhammadiyah Surakarta, Jawa Tengah, Indonesia, [b]Pendidikan Matematika, Universitas Sriwijaya, Sumatera Selatan, Indonesia, Email: [a]*arus874@ums.ac.id, bzulinuraeni@fkip.unsri.ac.id,

This study aims to describe the effect of the quantum learning model with the make a match method on cognitive abilities in grade 5 students in elementary schools. This type of research is quantitative research with quasi-experimental design. The research subjects consisted of an experimental class and a control class. The experimental class was treated using a quantum learning model with the make a match method while the control class was treated using a cooperative learning model. Data collection instruments are tests of cognitive ability. The results of the pre-test from the experimental and control classes indicate the cognitive abilities of students before learning are normal and homogeneous. Learning was carried out for three meetings. After learning, the experimental and control classes were given a post-test to find out the cognitive abilities of each class. Hypothesis testing uses the comparative Z test of two independent samples. The results of calculations show the value $Z_{calculated}$ is 2.46 with Z_{table} is 1.6425, the significant level of 0.05. The results show that the $Z_{calculated}$ is greater than the Z_{table} so that H_o is rejected while H_a is accepted. These results indicate that the cognitive abilities of students who apply the quantum learning model with the make a match method are better than students who apply the cooperative learning model.

Key words: *Quantum, Learning Model, Make A Match, Cognitive, Mathematics.*

Introduction

Mathematics is a subject that needs to be given to all students starting from elementary school to equip students with the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to cooperate (Soviawati, 2011: 80). The teachers should provide interesting and contextual mathematics learning so that students will not have difficulty in understanding mathematics (Retnowati, Ayres, Sweller, 2017). An interesting learning process will affect the achievement of learning objectives. Learning conducted in this study is learning by using the quantum learning model with the make a match method. The material taught is the addition and subtraction of different denominator fractions; according to Hidayati (2012: 88) mathematics learning, especially adding fractions has an important role in developing thinking skills logically, systematically, and creatively. Therefore, it is necessary to improve mathematics learning, especially in addition and subtraction of different denominator fractions.

The implementation of mathematics learning in elementary schools requires the application of appropriate learning models, such as the quantum learning model (Solikhah, 2017) (Kusuma, Gunarhadi & Riyadi, 2018). According to Sholikhah (2017: 132-133) quantum learning is a fun learning model, which includes all aspects of learning to support the success of learning and emphasises cooperation between teachers and students to achieve goals (Ulandari & Surya, 2017). Through the use of quantum learning models, learning is expected to provide a sense of fun and comfort (Purwaningrum, 2016). The use of good learning models must also be supported by the selection of the appropriate method. By using the make a match method, learning will be more meaningful (Susanti & Radia, 2019). According to Wibowo (2015: 160) the make a match method is an interesting learning method to be used in repeating material that has been given previously. With the repetition of material, students will better understand the material delivered by the teacher (Khairunnisa, Rahayu & Bintoro, 2018). Understanding the material in learning mathematics requires repetition of the material delivered by the teacher.

The implementation of learning certainly has learning objectives, one of which is the cognitive abilities of students. Achievement of cognitive abilities is proven by the ability of students to understand the material that has been presented by the teacher. Cognitive aspects are important to develop because with cognitive aspects students can obtain knowledge. According to Setiadi (2016: 169) cognitive ability is the appearance that is observed as a result of an activity or process of gaining knowledge through experiences. Cognitive domain, according to Bloom's taxonomy which was revised by Anderson and Krathwohl (Basuki, 2014: 13-14), is divided into 6 categories, starting from the simplest to the complex, namely remembering (C-1), understanding (C-2), applying (C-3), analysing (C-4), evaluating (C-5), and creating (C-6). In developing cognitive aspects of students, teachers must be able to pay

attention to these categories because cognitive aspects are a unified whole. Researchers take cognitive abilities as the dependent variable because cognitive abilities are the goals achieved in the implementation of learning.

In many elementary schools in Indonesia, there is a problem, namely the lack of student understanding of mathematics learning material. This problem is caused by learning that is less innovative and does not use media in the learning process. Students often show poor learning attitudes. For example, students are less active in the learning process, students feel bored, and do not feel excited. Poor understanding will cause students to get low learning outcomes. Therefore, it is necessary to improve the learning process by using innovative models, strategies or methods.

Quantum learning is effective when it is applied in mathematics learning, which is proven by the learning outcomes that students who are taught using quantum learning are better than students who are not taught with quantum learning (Sholikhah, 2017: 135). Other research states that students' mathematics learning achievement who participate in cooperative learning with the technique of finding a partner (Make a Match), is better than the learning achievement of students who take conventional way of learning (Artawa, 2013). Based on the result analysis of previous studies, there has been no research that combines the quantum learning model with the make a match method. The application of learning models will be maximised in improving students' cognitive abilities if the learning methods used are well chosen, according to the material being taught. The purpose of this study is to examine whether there is an influence of the use of the quantum learning model with the make a match method on cognitive abilities (Puspitasari et al, 2019: Bakhyt et al, 2018).

Method

Research Types and Design

This type of research is a quantitative research. A quantitative research is a research that is specifically planned in the form of causal thinking, and data collection is in the form of numbers (Drew, 2017: 28; Emzir, 2010: 28). The study used an experimental research design. Experimental research is quantitative research that is used to examine the causal relationship (Emzir, 2010: 64) (Sukmadinata, 2011: 194).

The study was conducted at SDN 1 Sawahan in May-June 2018, which was divided into several stages, starting from the process of collecting data to the process of writing reports. Researchers took the population of class V students at SDN 1 Sawahan, VA class as an experimental class with a total of 33 students, while VB class as a control class with a total of 27 students. The independent variable used is the quantum learning model with the make a

match method. The dependent variable used is cognitive ability. Cognitive ability is the ability to understand material in learning through students' experiences that has several stages, which are related hierarchically. The experimental class was treated using a quantum learning model with the make a match method, while the control class was treated using a cooperative learning model.

Techniques and Instruments of Data Collection

The technique of data collection used is a cognitive ability test. The instruments used for data collection are pre-test and post-test. Before the implementation of learning process, the experimental and control classes were given a pre-test of cognitive abilities. The results of the pre-test are used to determine that the initial abilities of the experimental and control classes are homogeneous (equivalent) and are distributed normally. The results of the post-test are used to test the hypothesis that is whether students who apply the quantum learning model with the make a match method have better cognitive abilities than students who apply the cooperative learning model.

Testing research instruments used are the validity test and the reliability test. The validity value of the pre-test instrument is more than 0.514. The validity value of the post-test instrument is more than 0.514. The reliability value of the pre-test instrument is 0.89 (very high), the reliability value of the post-test instrument is 0.93 (very high). These results indicate that the research instrument is valid and reliable.

The number of pre-test for cognitive abilities test items is 20 questions. The number of post-test for cognitive abilities test items is 20 questions. The cognitive ability test grid is as follows:

Table 1: Grid of cognitive abilities tests

Indicator	Number of Cognitive Ability			Number of Questions
	Implementing (C3)	Analysing (C4)	Evaluating (C5)	
Determine how to add two or more fractions with different denominators	1, 2, 4, 6	5	3, 7	7
Determine how to subtract two or more fractions with different denominators	9, 10, 13	8, 12, 18	11	7
Determine the method of Calculating a mixture of two or more fractions with different denominators	-	16	14, 15, 17, 19, 20	6
Total number of questions				20

Technique of Data analysis

The technique of data analysis used at the beginning is normality test, homogeneity test, and hypothesis test.
Normality Test uses Chi-Square Test (X2) with the following formula:

$$X^2 = \sum \frac{(O-E)^2}{E}$$

Note:
O : frequencies observed in cells; E : expected frequencies (pi x N); N : many numbers in data. (Gunawan, 2015: 68)

Homogeneity Test is calculated by finding F with the formula:

$$S_x^2 = \sqrt{\frac{n.\sum X^2 - (\sum X)^2}{n(n-1)}} \qquad S_y^2 = \sqrt{\frac{n.\sum Y^2 - (\sum Y)^2}{n(n-1)}}$$

$$F = \frac{S_{big}}{S_{small}}$$

Note:
S^2: variant; n: many data; x : data x_1; y : data x_2 (Setyosari, 2010: 215)

Hypothesis Testing uses z test for two independent samples with the formula as follows:

$$Z = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

Note :
$\overline{X_1}$: Sample average 1; $\overline{X_2}$: Sample average 2; σ : Variant of population; n: Total of samples (Subagyo, 2012:181)

Results and Discussion

Data on Student Mathematical Cognitive Ability

Data on cognitive abilities of mathematics were obtained from scores of questions that had been given, namely as many as 20 items of multiple choice questions.

Figure 1. Diagram of cognitive ability post-test in control class

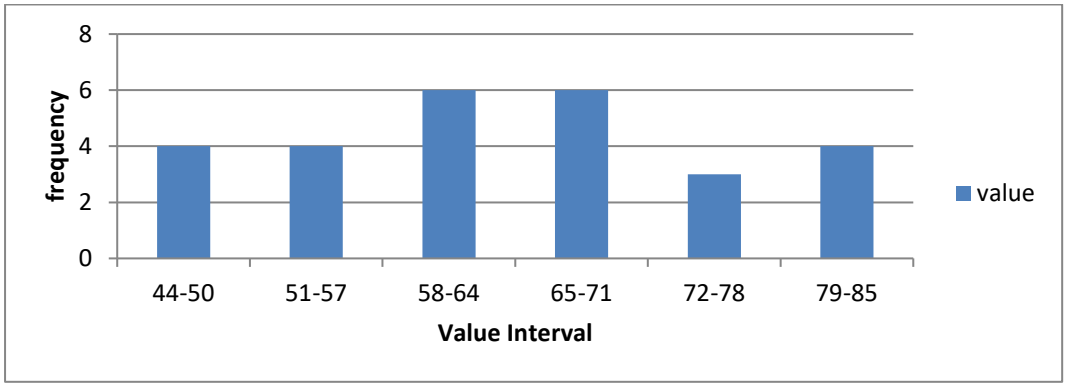
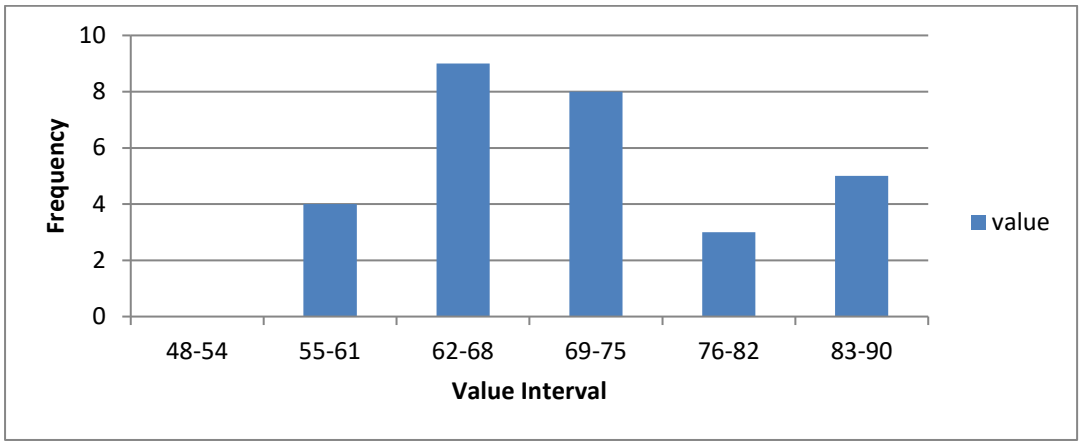


Figure 2. Diagram of cognitive ability post-test in exerimental class



Prerequisite Test and Hypothesis Test

The prerequisite test used in the study consisted of normality test and homogeneity test. The prerequisite test was used to find out whether the data will be processed using parametric or non-parametric statistics.

The normality test was used to find out whether data were distributed normally or not. The normality test uses Chi-Square test (X^2) with significant level 0.05 and obtained X^2_{table} 7.81. Data are called normally distributed if $X^2_{calculated} < X^2_{table}$. The results of normality calculation of the data obtained are as follows:

Table 2: Normality of cognitive ability data

Class	Type	$X^2_{calculated}$	X^2_{table}	Note
Experimental	Pre-test	4.369	7.81	Normal
Control	Pre-test	2.343	7.81	Normal

From this table it can be concluded that the cognitive abilities of students in both control and experimental classes are distributed normally.

Homogeneity testing is calculated by finding the value of F calculated compared to F table. The date are said to be homogeneous if $F_{calculated} < F_{table}$. Value of $F_{(32.26)}$ on table was found to be 1.88; the calculation data for the homogeneity test are as follows:

Table 3: Homogeneity of Data

Data	Type	$F_{calculatedhitung}$	F_{table}	Note
Cognitive Abilities	Pre-test	1.51	1.88	Homogeneous

From the table it can be seen that the cognitive abilities of the students in the control class and experimental class are homogeneous. Thus it can be concluded that the experimental class and the control class have the same initial ability before treatment has been given. Based on the table, it can be concluded that the control and experimental classes are homogeneous, so that hypothesis testing can be done with parametric statistics.

Hypothesis testing uses two different independent means by using the Z test to find out whether the experimental class has better cognitive abilities than the control class.

Hypothesis testing first determines H_0 and H_a, with the formulation of hypothesis:

H_0: The cognitive ability of experimental class is no better than the control class.

H_a: The cognitive ability of experimental class is better than the control class.

Condition:

H_0 is accepted if $Z_{calculated} \leq Z_{table}$

From the calculation results, the value of $Z_{calculated} = 2.46$ for Z_{table} with a significant level of 0.05 is obtained at 1.645. Because $Z_{calculated} > Z_{table}$, H_0 is rejected. Based on these data, it can be concluded that the cognitive abilities of the students in the experimental class are better than those in the control class.

The Effect of Using the Quantum Learning Model with the Make a Match Method on Students' Mathematical Cognitive Abilities

This study aims to examine the effect of the quantum learning model with the make a match method compared to the cooperative learning model in terms of students' cognitive abilities. Conclusions are drawn by comparing the results of the post-test between the experimental class and the control class. Homogeneity test results from the pre-test between the control class and the experimental class prove that the cognitive abilities of the control class and the experimental class are homogeneous (the same). Students in the experimental class apply the quantum learning model with the make a match method. Students in the control class apply the cooperative learning model. The material taught is the addition and subtraction of different denominator fractions. The number of meetings for learning was held 3 times. After the learning process has been finished, the experimental class and the control class are given a post test in the form of a cognitive ability test.

The quantum learning plan of framework is as follows: (1) Encouraging the environment, where students are given stimulation so that students have a high curiosity and want to know much more; (2) Naturally, presenting learning experiences that are easily understood by students; (3) Name it, giving meaning to the concepts that have been learned; (4) Demonstrate it , students are given the opportunity to express the knowledge gained; (5) Repeat it, repeating activities with the material that has been delivered, through questions and assignments; (6) Celebrate it, give a celebration on what students have gained in the form of learning experiences and learning materials. The use of the quantum learning model in learning must also pay attention to appropriate learning methods for the material that is

delivered (Suryani, 2013) (Kusno & Purwanto, 2011). The steps in the make a match method are (1) The teacher prepares cards; (2) Each student gets a question card; (3) Every student looks for an answer card, students are given time to answer the question on the card; (4) Students who answer correctly and get the right cards get points; (5) Cards are shuffled again and dealt; (6) Conclusions (Utomo, Sukarno & Sriyanto, 2018) (Sundari & Suryadi, 2018).

Data analysis shows the value of $Z_{\_calculated}$ = 2.46. The $Z_{\_table}$ significant level of 0.05 is 1.645. Because $Z_{\_calculated} > Z_{\_table}$, then H_0 is rejected and Ha is accepted. Based on these data, it can be concluded that the use of a quantum learning model with the make a match method to the cognitive abilities of fifth grade students in mathematics is better than the use of cooperative learning models.

Quantum learning provides suggestions that can affect learning outcomes with learning activity which comes together with excitement (Suyono, 2015: 38). Students direct involvement in learning activities can make the new knowledge obtained by students will stick to and imprint longer; the principle of quantum learning makes students directly involved in learning (Khotimah, 2017: 82) (Rumapea, Syahputra & Surya, 2017). The results of research conducted by Khotimah prove that there is a significant effect of the application of the quantum learning model with the method of discussion of learning outcomes in mathematics ((Puspitasari et al., 2019).

The combination of quantum learning models with the make a match method can also affect learning outcomes. The advantage of the make a match method is that students look for partners while learning to understand concepts (Rusman, 2012: 223). This is in accordance with the quantum learning model because students are directly involved so that the concepts obtained will be more meaningful. Make a match method helps students to understand the concept of material in a pleasant atmosphere (Hidayah, Suharno & Indriayu, 2017). This is seen when students are given cards containing questions and answers. Students enthusiastically look for pairs that match the cards they have. There is an influence of the cooperative model of make a match technique on student learning outcomes in mathematics learning (Fauzi, Usodo & Subanti, 2017).

Mathematics learning using quantum learning models with the make a match method has a positive effect on students' cognitive abilities. This is proven by observing the implementation of learning; students can do the exercises given by researchers easily. Students are also very enthusiastic in learning and answering question cards given by researchers. Then students are asked to match with the answer cards that have been prepared. Students' cognitive abilities can develop better if students are involved in direct learning and learning that is associated with daily life. Thus, the material students learn will be more appropriate. Quantum learning also provides comfort to students, which is proven by

students' confidence when expressing their answers. Learning using the quantum learning model with the make a match method provides an opportunity for students to give more participation compared to cooperative learning. The learning process seeks to foster learning motivation with learning that is fun and gives students a sense of comfort (Godino et al., 2019).

Based on these explanations, it can be concluded that there is an influence of the use of quantum learning models with the make a match method on students' cognitive abilities. Students in learning are directly involved with a happy atmosphere so that learning becomes more meaningful. When participating in learning using the quantum learning model with the make a match method, students are enthusiastic and fight for the opportunity to express their answers about the given question exercises. In addition, the activity of searching for answer cards in accordance with the question cards obtained by each student also gives enthusiasm and pleasure. This activity provides a positive influence on students' motivation to learn mathematics. This is marked by students who are increasingly excited in participating in learning mathematics.

Conclusion

There is an influence of the use of quantum learning models with the make a match method on cognitive abilities. The value of $Z_{calculated}$ is 2.46. The value of Z_{table} is 1.645. The value of $Z_{calculated} > Z_{table}$, then Ho is rejected and Ha is accepted. Based on these data, it can be concluded that the cognitive abilities of fifth grade students in mathematics that implement the quantum learning model are better than the cognitive abilities of students who apply the cooperative learning model. Mathematics learning using quantum learning models with the make a match method has a positive effect on students' cognitive abilities. Students' cognitive abilities can develop better if students are involved in direct learning and learning that is associated with daily life.

Learning using the quantum learning model with the make a match method provides an opportunity for students to give more participation compared to cooperative learning. The learning process seeks to foster learning motivation with learning that is fun and gives students a sense of comfort. Students in the learning process are directly involved in a happy atmosphere so that learning becomes more meaningful. Students were enthusiastic, fighting for the opportunity to express their answers about the given question exercises.

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