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Mathematical Reasong and Math Anxiety on Connected Mathematics Project Based on Quantum Learning

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Abstract

This research aims were (1) to know the quality of Connected Mathematics Project based on Quantum Learning and (2) to describe the reasoning patern based on math anxiety category. This study was a mixed method research with using concurrent embedded design. The population was VII grader students of SMPN 2 Salam, Magelang regency. The subjects was selected based on math anxiety category, such as low, middle, and high level. Data was collecting by questionnaire, observation, test, and interview. The result showed that (1) Connected Mathematics Project based on Quantum Learning was on good category (2) Students with low level of math anxiety satisfied six indicators of mathematical reasoning, students with middle level of math anxiety satisfied three indicators of mathematical reasoning, and students with high level of math anxiety satisfied the two indicators of mathematical reasoning.

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INTRODUCTION

The Content Standards for Primary and Secondary Education Units state that mathematics subjects need 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 collaborate (BSNP, 2006). Mathematical skills are not in line with what is expected, because Indonesia is still at the Low International Benchmark Level in Trends in the International Mathematics and Science Study (TIMSS). Based on I.V.S. Mullis et al (2012) stated that the results of the 2003 TIMSS study showed Indonesia was ranked 35th out of 46 countries, in 2007 Indonesia was ranked 36th out of 49 countries, and in 2011 Indonesia was ranked 38th out of 42 countries.

The importance of mathematics in learning is aligned with the objectives of mathematics learning. Permendiknas No.22 of 2006 concerning competency standards for SMP / MTS (Depdiknas: 2006) states that the ability to use reasoning is one of the abilities that students must possess. According to Bergqvist & Lithner (2011), reasoning can be seen as a process of thinking, as a result of the process, or both. According to Ball & Bass (2003) states that mathematical reasoning is more than just basic abilities, so mathematical reasoning ability is an important ability to be developed. According to Manurung (2016) mathematical reasoning can be characterized as one part of the mathematical thinking process. The mathematical thinking process in question is thinking about understanding ideas, finding patterns or relationships between ideas, describing or supporting those ideas.

The level of mathematical reasoning ability is not yet in line with the importance of mathematical reasoning skills in Indonesia. Based on Mullis (2015) 2015 TIMSS data the achievement of students' mathematical reasoning abilities was 0.6%. There are several factors that influence mathematical reasoning ability, including internal factors. Ismawati (2015); Syafri (2017) states that the low performance of mathematics is also caused by the existence of math anxiety. Mahmood (2011) states that math anxiety is more than a feeling of dislike for mathematics. Mayer (2008) defines anxiety as a state of intense agitation, hunch, and fear, which occurs from a real threat or is considered an impending danger. Ashcraft (2002); Sheffeld and Hunt (2007) define math anxiety as a feeling of tension, anxiety or fear that disrupts the performance of mathematics. Aunurrofiq (2017) also expressed anxieties about mathematics which means worrying about everything related to mathematics. Anxious about not being able to work on the questions, anxious when taking mathematics lessons, anxious when asked by the teacher, and so on. Indications of this anxiety in the form of heart feeling beating faster or stronger, they believe they are unable to solve mathematical problems, and tend to avoid situations where they have to learn and do math. Negative consequences of anxiety about mathematics include low mathematical performance involving numerical reasoning (Nunez-Pena et al, 2013).

The results of the students' work in grade VII of SMP N 2 Salam showed that 65% students had not yet reached the mathematical reasoning indicator. Students have difficulty understanding the problem and doing mathematical manipulation, so drawing conclusions is still inappropriate. The teacher has not paid attention to the students anxiety, so it is very important that there is an effort to analyze mathematical reasoning ability based on anxiety level. There are several learning models that are supported by a strategy to improve the ability of mathematical reasoning, including the Connected Mathematics Project based on Quantum Learning.

Connected Mathematics Project based on Quantum Learning was a learning with the syntax of Launching, Exploring, and Summarizing based on growing, natural, naming, demonstrating, repeating, and celebrating steps. The aim of the Connected Mathematics Project is that all students can reason and communicate mathematics proficiently. The Connected Mathematics

Project is designed to investigate important mathematical ideas in developing students' understanding and reasoning (Phillips: 2001). Connected Mathematics Project assists students in developing an understanding of important concepts, skills, and ways of thinking, as well as reasoning on numbers, algebra, geometry/measurement, probability, and statistics (U.S Department of Education, 2010). Research conducted by Sukamto (2013) shows that the implementation of Quantum Learning with a constructivism approach can improve mathematical reasoning abilities. Quantum Learning is an interesting and fun learning that utilizes all the potential in learning moments, so that students are comfortable, motivated, and have a high interest in learning.

Based on this, it is necessary to conduct research on Mathematical Reasoning ability and Math Anxiety through the Connected Mathematics Project Based on Quantum Learning. The research objectives were (1) to know the learning quality of Connected Mathematics Project based on Quantum Learning and (2) to know mathematical reasoning based on math anxiety with Connected Mathematics Project based on Quantum Learning.

METODE

This research is a combination of qualitative and quantitative methods (mix method). This study uses concurrent embedded design. This design can also be characterized as a mixed method that implements one stage of collecting quantitative and qualitative data at one time (Creswell, 2014). This study uses qualitative research methods as the primary method and quantitative research as a secondary method. Quantitative research was a supporting data to analyze mathematical reasoning skills based on levels of math anxiety.

The population in this study were seventh grader of SMPN 2 Salam. There were 2 classes as the sample. The experiment class was VIIB and control class was VIIC. The research subject was taken by choosing two students on every category of math anxiety. Data was collected by questionnaire, observation, test, and interview. Quantitative data was started from item analysis, prerequisite test, test of hypothesis that consist of average test, proportion test, proportion difference test, and t test. Qualitative data were analyzed by qualitative descriptive method that refers to Miles and Huberman in Sugiyono (2015), such as data reduction, data presentation, and drawing conclusion or verification.

RESULT AND DISCUSSION

The quality of learning was obtained through the process and results of the implementation of learning. Quality of learning includes (1) planning and preparation, (2) classroom environment, and (3) professional responsibilities. The planning and preparation include the learning tools such as syllabus, lesson plans, student worksheets, and tests of mathematical reasoning skills. Validator assessment data are presented in Table 1 as follows.

Tabel 1. Validation Result

Learning Tools	Validation Result			Average	Category
	Val 01	Val 02	Val 03		
Syllabus	3.9	4.6	4	4.2	Good
Lesson Plan	3.8	4.3	4.2	4.1	Good
Student Worksheet	3.7	4.4	4.3	4.1	Good
Test	4	5	3.9	4.3	Excellent

Based on the validation result by validators, the average syllabus, lesson plan, and student worksheets were obtained in good category, while the mathematical reasoning ability tests were in the very good category. These results indicated that the device is suitable for research.

The classroom environment can be measured from the quality observation sheet and the learning environment sheet. The implementation of learning is said to be quality if the results of observations on the quality of learning. Implementation of learning if it is at least included in the good category. The results showed that the average quality and implementation of learning included in the category of minimal good, so it can be concluded that researchers prepare and manage learning well.

Qualitative learning assessment is carried out by giving student response questionnaires after learning is carried out. The results of the student response questionnaire indicate that the positive response of students is more than or equal to 70%, so it can be concluded that students respond positively to learning. In the quantitative assessment include prerequisite data preliminary tests that are normality and homogeneity test, average initial data similarity test, individual completeness test and classical final data, difference proportion test of reasoning ability in experimental class with control class, and t test.

The normality test of the initial data showed that the data comes from a normal distributed population, while the homogeneity test also shows that the variance is homogeneous, and the average similarity test shows that there is no difference in the average of the two classes. The results of the individual completeness test showed $t = 5{,}08 > 1{,}69 = t_{(1-\alpha)(n-1)}$ it means the average mathematical reasoning ability of students in the class with the learning of Connected Mathematics Project based on Quantum Learning achieved minimum completeness criterion. In the classical completeness test $z = 1{,}22 \geq 0{,}3888 = z_{0{,}5-\alpha}$, it means that the proportion of students in learning connected to Quantum Learning based on Connected Mathematics Project has exceeded 75%. In proportion difference test obtained $z \geq z_{0.5-\alpha}$, it means that the proportion of students 'reasoning ability in learning Connected Mathematics Project based on Quantum Learning is more than the proportion of PBL students' reasoning ability. The t test shows that $t = 7{,}05 > 1{,}99 = t_{tabel}$, it means that the average mathematical reasoning ability using the learning Connected Mathematics Project based on Quantum Learning is more than the average students' mathematical reasoning ability in PBL learning.

These statements show that learning using Connected Mathematics Projects based on Quantum Learning can be said to be high quality. This is also due to the syntax that is carried out during learning will lead students in habituation to reason the problem given. The initial goal of the Quantum Learning strategy is to provide a comfortable atmosphere during learning. This learning model and supporting strategy will certainly develop students' reasoning in a pleasant atmosphere. Learning Connected Mathematics Project based on quality Quantum Learning is in line with the research conducted by Mulyani (2017) that the average mathematical reasoning ability in a class with the learning of Connected Mathematics Project based on Quantum Learning is higher than the average reasoning ability in conventional learning classes. The research conducted by Sari (2014) and Senimbar (2015) also produced a cognate conclusion that the learning of Connected Mathematics Project can improve the mathematical reasoning ability of VII graders. Another study also conducted by Sukamto (2013) stated that Quantum Learning strategy with constructivism approach can improve mathematical reasoning ability. Firdaus (2013) also states that Quantum Learning is more effective in increasing mathematical reasoning.

The pattern of mathematical reasoning ability in terms of low math anxiety categories is as follows. Based on the results of the study, in

general students with low anxiety categories can solve mathematical reasoning problems well. One student with a low anxiety category can even get the highest score among his classmates. Low anxiety category students are able to identify / analyze problems well. Students are able to explain what is known and asked well. Students with the low level category are able to mention what is known in questions number 1 through 7. This is because students feel calm when working so that students really understand what is meant in the problem.

Low anxiety level students are able to plan work strategies in solving problems. This is shown from the coherence of the working strategy taken. Although the questions number 4 and 5 students do not write it, but in the matter of 1,2,3,6, and 7, students are able to write down the working strategy correctly. Students with low anxiety categories are also able to use formulas correctly. In addition, students are careful in calculating. In the final stages of work, students can reflect on the solution to the problem. Based on this explanation, in general students with low anxiety categories can fulfill all mathematical reasoning indicators. Students are able to analyze, unite, evaluate, draw conclusions, generalize, and give reasons correctly on the answers to the questions given. The results of research by Kargar (2010: 541) state that students who have low math anxiety tend to have high mathematical thinking.

Based on research data, students with middle anxiety categories can only solve a number of mathematical reasoning questions well. In general, students with an anxiety category are not able to fulfill all mathematical reasoning indicators. Students with anxiety categories are able to analyze, unite, evaluate, but have not been able to draw conclusions, generalize, and give reasons correctly on the answers to the questions given. On completion of each item, students with anxiety categories are able to identify / analyze problems well and are able to plan work strategies in solving problems. Of the 7 questions given, the average student with a middle anxiety category was able to identify / analyze problems and develop work strategies.

In the next stage students have not been able to use the formula properly and reflect the solution to the problem. Students in the anxiety category are having difficulty determining the right formula when dealing with formulas. Of the 7 questions given, students in the anxiety category are only able to complete the stage of using the formula on 3 questions. A discussion by Maloney & Beilock (2012) says that math anxiety is a contributor to the causes of low mathematical abilities. That is, someone with math anxiety is less skilled and practices in the field of mathematics than those who do not experience anxiety. While low mathematical abilities are not a cause of anxiety. It has been proven that people who experience excessive anxiety are obstacles to achievement in the mathematical subject. When faced with mathematical tasks, individuals who experience anxiety will worry about the situation at hand and the consequences. These concerns interfere with cognitive resources, such as memory, short-term systems, and controlling information relevant to the task at hand. When the memory capability that serves to maintain focus is disrupted, then the mathematical performance will be disrupted as well.

Students with high anxiety categories are able to go through the stage of identifying / analyzing problems. Of the 7 questions given, the average high-anxiety category students were able to identify problems in 4 questions. While the remaining 3 questions still cannot be identified properly. The next step is to write down the working strategy to solve the problem. Wu et al (2012) stated that mathematical reasoning presents a series of verbal and visual problems that assess the ability to reason mathematically. Students with high anxiety categories have not been able to write down a work strategy. According to Slavin & Lorenz in Homayouni (2013) states that math anxiety means an emotionally oriented reaction that stops the student's mind when facing a mathematical problem or when a test is given. This is natural when students have difficulty

thinking about determining work strategies when experiencing anxiety.

The next step in solving reasoning problems is to use formulas and reflect solutions to problems. Maloney & Beilock (2012) state that anxiety is also related to different patterns of neural activity in the brain associated with negative emotions and numerical calculations. Students who experience relative anxiety show an increase in brain activity against negative emotions than students who do not experience anxiety. This supports a decrease in memory activity and processing that is numerical in the brain. Further information was conveyed by Homayouni et al (2013) that math anxiety has been universally recognized as a non-intellectual factor that impedes mathematics achievement. Some students who perform poorly in math assessment have a full understanding of the mathematical concepts being tested. However, their anxiety disrupts their ability to solve math problems. Based on this information, students with high anxiety will feel disturbed by their own anxiety when using formulas and reflect solutions to problems. Students will feel unable to use formulas that have an impact on the stage of reflecting the solution to the problem.

CONCLUSION

Based on the results and discussion, the following conclusions are obtained. The average mathematical reasoning ability of students in the class with the learning of Connected Mathematics Project based on Quantum Learning achieved minimum completeness criterion. The proportion of students in learning connected to Quantum Learning based on Connected Mathematics Project has exceeded 75%. The proportion of students 'reasoning ability in learning Connected Mathematics Project based on Quantum Learning is more than the proportion of PBL students' reasoning ability. The average mathematical reasoning ability using the learning Connected Mathematics Project based on Quantum Learning is more than the average students' mathematical reasoning ability in PBL learning. Those means the quality of learning Connected Mathematics Project based on Quantum Learning on the mathematical reasoning ability of grade VII students in solving problems in mathematical reasoning skills qualitatively belongs to the good category. The pattern of mathematical reasoning ability in terms of math anxiety is as follows. Students with low anxiety categories can solve problems with a near perfect completion stage. Students with low anxiety categories can solve the problem until the stage reflects the solution to the problem. Students with low anxiety categories can reach the six indicators of mathematical reasoning. Students with anxiety categories are already fulfilling the stages of identifying problems and reflecting solutions to problems, but are still lacking in making strategies and using formulas. Students with middle anxiety category can fulfill three mathematical reasoning indicators. Students with high anxiety categories fulfill the stage of identifying/analyzing problems, but are still lacking in planning strategies, using formulas, and reflecting problem solutions. High anxiety students meet two indicators of mathematical reasoning.

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