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Connected Mathematics Ability Seen from Student Cognitive Style on STAD – *Peer Tutoring* Learning Model

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Abstract

Connected mathematics ability of students and students' cognitive style are important in learning mathematics. This research aims to (1) find out effectiveness of STAD (*Student Team Achievement* Division) – *Peer Tutoring* learning model to connected mathematics ability of students, and (2) describe connected mathematics ability of students seen from cognitive style. This research was done for eighth graders of one of Islamic JHS in Cirebon within academic year 2018/2019. This *mixed method* research with *concurent embedded* design used observation, cognitive style test, student connected mathematics ability test, and interview as techniques of collecting data. The technique of analyzing data was quantitative data analysis: parametric statistic and descriptive-qualitative analysis technique. The findings showed: (1) STAD-*Peer Tutoring* was effective to connected mathematics ability of the students; (2) students with *Field Independent* (FI) cognitive style were able to connect each topic in mathematics, to connect mathematics concept to other discipline of knowledge, and to connect mathematics to daily life based on the given facts. Students with *Field Dependent* (FD) were able to connect mathematics concept to other diciplines of knowledge and to connect mathematics to daily life.

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INTRODUCTION

Mathematics is ability owned by students to make them able in facing mathematics problems specifically and daily life problems in general (Sapto et al., 2015). It is supported by Dinni (2018) stating that mathematics is knowledge which can be used by students to solve daily life problems. However, to solve the existing problems, students should know the connection between problem and mathematics. Therefore, students must have ability to connect mathematics concepts to daily life. This ability is known as connected mathematics ability (Ramdani, 2012).

According to National Council of Teacher Mathematics (NCTM) (2003), one of mathematics ability aspect is to connect ideas. This ability comes from topic-interrelations on mathematics or connected mathematic topic to other disciplines of knowledge. Students with high inter-connected topic understanding tend to have better connective mathematics problem solving level to connect other mathematics concepts.

Connected mathematics ability of students is high order mathematics thinking. It is in line with Dewi (2017) stating that generally, high order mathematics thinking consisted of problem solving, mathematics reasoning, mathematics communication, and connective mathematics abilities.

The purposes of learning mathematics in 2013 curriculum are – to be able to understand mathematics concepts, to explain connection among concepts, and to implement concepts accurately, efficiently, appropriately, and flexibly in solving problems. However, the facts showed that it has not been fully realized. Results by Trends in International Mathematics and Science Study (TIMSS) in 2015 showed that both factual and procedural mathematics abilities of Indonesian learners were still low. Indonesia was still in 44th rank of 46 surveyed participating countries (Mullis et al., 2015).

Dealing with connected mathematics ability, Ni'mah et al (2017) concluded that the eleventh graders of a Junior High School in conducting connected mathematics on sub-subject geometry was still low. It was in line with the answer results of mathematics questions of a JHS in Cirebon which measured connected mathematics ability by taking indicator to inter-connect concepts in mathematics. The students had not achieved indicator of connected mathematics ability. Furthermore, the researcher also questioned the teacher and noticed that the students had not been able to realize that mathematics had concept inter-connection.

Mathematics learning process in Indonesia needs changes to achieve the demanded objectives, especially dealing with teachers' efforts to develop connected mathematics ability of students. This effort to improve education quality and the ability is based on cognitive skill and cognitive character developments of students in learning mathematics (Nur & Palabo, 2018).

Factor which plays important role in developing thinking ability and cognitive characteristics of students is cognitive style. The style is formulated as behavior, choice or stable strategy to let unique ways of individuals in remembering, thinking, and solving problems. Stenberg and Elena argue that cognitive style is a bridge of intelligence and personality (Ulya, 2015).

Witkin classified cognitive style into Field Independent (FI) and Field Dependent (FD) (Desmita, 2014). FI students tend to be less interested in social phenomenon. They are interpersonally less intimate and feeling to be more efficient to work independently without depending on his teachers. FD typed students can be categorized as global thinkers, sensitive and socially behaving with interpersonal orientation. They like working in group to finish their tasks.

There are several models which can be used to improve the ability, one of them is STAD-peer tutoring. It is supported by Paitung's finding (2017) concluding that activeness and learning achievement of students taught by STAD could achieve the passing grade. It also influenced positively to activeness and learning achievement of the students.

STAD-peer tutoring learning model is featured by task structure, purpose, and cooperative acknowledgement. Learning lasts in groups and the students can select their peers as their tutors to

explain in front of each team. According to Suyitno & Rochmad (2015), in STAD learning, students cooperated in encouraging and cooperative learning situation such as by having cooperation to reach collective purpose and to coordinate any efforts to complete the task.

STAD is a learning model developed by Robert Slavin. It is the simplest cooperative learning model and best to use by new teachers (Hafizah et al., 2018). Through this model, students are expected to more understand mathematics concepts given during learning and to know its functions.

Based on the explanation, this research's purposes are (1) to find out effectiveness of STAD – Peer Tutoring learning model to connected mathematics ability of the students and (2) to describe connected mathematics ability seen from cognitive style.

METHOD

This mixed method research with concurrent embedded design is identified as mix method strategy by determining one step of collecting quantitative and qualitative data in a time (Cresswell, 2014). Quantitative research as supportive data in collecting and analyzing was used to find out effectivness of the model to connected mathematics ability of the students. Meanwhile, qualitative data analysis was used to find out cognitive style of the students before the intervention and to describe connected mathematics ability of the students based on their cognitive styles. This research was done in Islamic JHS NU Putra 2, Buntet, Cirebon in academic year 2018/2019. The population consisted of all eighth graders of the school. The sample consisted of two classes – VIII A as experimental group and VIII B as control group. The sampling technique used random sampling.

Before conducting the research, an initial test of connected mathematics ability of the students was done to find out criteria of the students' minimum passing grade. The test consisted of 4 questions dealing with connected mathematics skill and was combined by geometry daily question test of the teacher. Based on the initial test, their connected mathematics abilities on the population were: (1) the average score of connected mathematics ability of them ($\bar{x}$) was 62 with deviation standard (s) 10.05. therefore, the minimum passing grade criteria in this research was $\bar{x} + \frac{1}{4} s = 65$; (2) normality and homogeneity's Sig scores were 0.177 > 0.05 and 0.9830 > 0.05 thus it could be concluded that the initial data was normally and homogeneously distributed. Thus, the samples were randomly taken: experimental group (VIII A) and control group (VIII B). After that, homogeneity test of initial average score of the ability of both groups was done. It gained Sig score 0.890 > 0.05. It showed that the initial average scores of the students' connected mathematics ability of both groups were not different significantly. After the intervention for both groups, a posttest was done and its data was used to analyze.

The experimental group as subject of quantitative research consisted of 28 students taught by STAD – Peer Tutoring and was analyzed by using its connected mathematics ability test result. Then, its four students were taken based on GEFT (Group Embedded Figure Test) of cognitive style to describe their connected mathematics ability.

Quantitative step used quasi experimental research design with pretest-posttest control group. In this part, the research used two randomly taken classes as experimental and control groups. The quantitative data was gained from a test based on three connected mathematics ability indicators: (1) inter-connecting topics in mathematics, (2) connecting mathematics concept to other disciplines of knowledge, and (3) connecting mathematics to daily life. The data was tested by using individual passing grade, classical passing grade, and average deviation tests.

This research quantitative step was done simultaneously with quantitative step. It had purpose to analyze connected mathematics ability of the students seen from cognitive style. The findings of this research step were combined by the findings of quantitative step. The subject selection was done by purposive sampling to choose expected participants.

The qualitative data was gained from GEFT test, subject interview dealing with their answers, data reduction, data presentation, and data conclusion. In

this research, the qualitative focus was on each category of the students' cognitive styles – FI and FD groups.

RESULT AND DISCUSSION

Learning Effectiveness

The quantitative research was done to analyze learning effectiveness taught by STAD – Peer Tutoring. It was effective when: (1) average of the students' connected mathematics ability reached minimum passing grade score criterion, 65; (2) 75% of the students passing the minimum grade; (3) better connected mathematics ability of the students taught by STAD – peer tutoring learning model than the control group.

After conducting the research and analyzing the data, it showed that: (1) based on One-sample Test calculation, t_{count}=2.883 > t_{table} = 1.69. Then, H0 is denied. It meant the experimental group's connected mathematics ability reached the minimum grade, 65; (2) based on the calculation of one side proposition test, it gained z_{count} = 3.06> z_{table} = .1.64. Then, H0 is denied. More than 75% of the experimental group connected mathematics skill was considered passing the grade individually and classically; (3) based on Independent Sample Test, it gained that t_{count} = 2.023 > t_{table} = 2.005 with error level (α) = 5% = 0.05 and based on $dk = n_1 + n_2 - 2$ then H_0 is denied. It means that the experimental group's connected mathematics ability was higher than control group.

Based on those three statistical tests, learning taught by STAD – Peer Tutoring was effective to the students' connected mathematics ability seen from cognitive style.

The Students' Cognitive Mathematics Ability Seen from Cognitive Style

The qualitative part was done to describe the students' connected mathematics ability based on cognitive style. It was analyzed based on GEFT. The test was done before intervention. Then, some students were selected as subjects. Based on GEFT result, the students were grouped into two categories based on cognitive style: Field Dependent (FD) and Fiend Independent (FI)

From the test, four students were selected as subjects to be interviewed. It was done to get complete data. Based on GEFT qualification, there were 10 students categorized as FI and 18 students categorized as FD from 28 students of experimental group. Analysis of FI subjects covered strong FI (FIK) and weak FI (FIL). Meanwhile, analysis of FD subjects covered strong FD (FDK) and weak FD (FDL). The subjects were analyzed qualitatively. Each of them had different characteristics while answering connected mathematics ability question test.

On the indicators to inter-connect topics in mathematics, FIs and FD had differences. FDLs were incapable to inter-connect the topics in mathematics because they answered the questions incompletely with inaccurate conclusion.. It is in line with Vadiagrys et a (2015). They showed that FDLs were frequently performed less accurate answers.

Dealing with connecting mathematics concepts to other disciplines of knowledge, FIs were able to do it while FDs were not. The steps in answering the question indicators done by FDs were still inaccurate since they could not broaden their obtained connected mathematics solution. It is in line with Vendiagrys et al (2015) stating that FDs could not broaden their obtained solution.

Dealing with indicators to connect between mathematics and daily life, FIs and FDs tended to be similar. Most of FIs and FDs could write any known and questioned things from the question until conclusion of each answer. The differences were on the writing, FDS wrote exactly same as the questions while FIs tended to write with their own language. FDs adopted a certain global orientation to understand and process certain information while FIKs answered accurately and correctly started from information of the questions, the questioned problems, until the final conclusion. It is in line with Widarti (2013) telling that high connected mathematics ability students met all indicators of the ability. When students have good connected mathematics ability, they will able to solve problems with clear and systematic steps. It is supported by

Yuniawatika (2011) concluding that students who could do the ability properly would have better understanding because they realized the current learnt materials still were related to previous materials.

In processing the known information from the questions, FIK tended to be more analytic so they could find any important part to solve problems. FI typed students started by arranging the answer plan based on given facts. They were analytic and tended to be more independent in learning process. It is supported by Amstrong (Vendiagrys et al., 2015) showing that FIs tended to adopt analytic orientation to understand and process information.

The subjects wrote the recognized and questioned information by using mathematics notation with their own language. Morgan (Kheirzaden & Kassian, 2011) stated that when the geometry was not clearly organized, FIs tended to apply their own structures.

FILs answered correctly and appropriately on conclusion part to connect mathematics with other disciplines of knowledge. However, FIKs answered the CMA test without writing the known and questioned things. They answered it quickly without carefully checking them. It is known that carefulness or precision are important because topics in mathematics always are always correlated each other so it needs high order thinking and precision. However, in another hand, criteria of FILs were active in group discussion and confident. Jurotun (2017) stated that STAD learning model made FI typed students to participate, to be more active, and to be braver in delivering opinion.

FDKs were less able to connect each topic in mathematics. It was due to many topics must be correlated to their solution. Thus, it needed high order thinking. According to Siahaan et al (2012) concluding that indicators of mathematics inter-connected topics of the students were still low. It was caused since mathematics had relationship to its solution so it needed broader thinking.

FDLs were able to connect mathematics to daily life. They answered the CMA test well. The subjects wrote with brief, clear, and accurate sentences while answering the questions which correlated to daily life.

According to Rohendi (2012) mathematics connection is student understanding in connecting mathematics ideas which facilitate formulating ability and verify deductive assumptions among topics. It meant that mathematics concept and procedures they gained could be used to solve problems in mathematics or other disciplines of knowledge or event to solve real life problem faced by them now or in the future.

Connected mathematics ability is needed by them in learning inter-connected mathematics concepts. The findings and analysis showed that with different cognitive style, the students had different CMA. It does not that a certain cognitive style is better than the other. Cognitive style is combination of how individuals understand, manage, and process information (De Porter & Hernacki, 213). Thus, cognitive style is important in learning. Several studies had proven that teacher who realized cognitive style and best ways of students' learning could improve students' learning achievement (Eyyam, 2011).

CONCLUSION

Based on the findings, it could be concluded that: (1) learning mathematics taught by STAD – Peer Tutoring was effective to connected mathematics ability based on cognitive style so that it could be used as an alternative to develop students' connected mathematics ability; (2) Field Independent typed students (FI) were able to connect topics in mathematics and to connect mathematics with other disciplines of knowledge. They were also able to connect mathematics into daily life based on given facts. Field Dependent typed students were able to connect mathematics concept to other disciplines of knowledge and connect mathematics into daily life.

Solution from the findings was the difference of the students' cognitive styles showed different connected mathematics ability. Before learning, teacher should recognize each of his students' connected mathematics ability and should give appropriate learning to their cognitive styles.

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