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The Effect on Mathematical Learning Outcome by Modelling of Mathematic Learning and Cognitive Style of Junior High Students

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Abstract

The objectives of this study are (1) to examine a difference between the learning outcome of junior high school students who participate in Realistic Mathematic Learning (RML) and expository, (2) to examine a difference between learning outcome of students who have cognitive style of Field Dependent (FD) and Field Independent (FI), and (3) to examine an interaction between the students who participate in RML and cognitive style on mathematical learning outcome. The study is conducted at two religion-based state junior high school in Surabaya, Indonesia. Data collecting instrument of cognitive style uses Withkin's Group Embedded Figure Test (GEFT). The test is used to measure mathematical learning outcome. The results of study show a significance value on PMR of 0.001 < 0.05 with F-count = 10.715. For the significance value on cognitive style, it is obtained a significance value of 0.000 < 0.05 with F-count = 180.928. While the significance value on RML and cognitive style, it is obtained 0.013 < 0.05 with F-count = 6.311. So, it can be concluded that (1) there is the difference between learning outcome of students who participate in PMR model and expository learning, (2) there is the difference between learning outcome of the students who have a cognitive style of FD and FI, and (3) there is the interaction between RML model and cognitive style on students' learning outcome.

Keywords:
Realistic mathematics learning
Cognitive style
Mathematics learning outcome
Expository
Field Dependent (FD)
Field Independent (FI).

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1. Introduction

Mathematics subject is a curricular program that aims to develop students' attitude, knowledge, and skill competencies as a basis and capacity building in the life of society, nation and state (Ministry of Education, 2013). For some students, mathematics is a fun lesson. Resolving difficult math problems is a priceless satisfaction. What about some others who think that mathematics is a scary lesson? Not infrequently also found that their teaching teacher looks serious and expensive smile, so the students give the term to their teacher as killer. This fear builds an image that mathematics is a scourge because the lessons are difficult and they even assume that mathematics have little to do with their everyday life. As a result, each year, the average national exam score in mathematics is D.

Suryaman and Subandowo (2015) explained that the students' mathematics mastery in Indonesian ranked 2nd lowest (ranking 39 out of 41) compared to other subjects. The mathematical skills which are mastered by the students are only capable of completing a single step of mathematical problems, applying mathematical basic skills, recognizing information that is diagram and text in nature which are easily recognizable and not

complex, and applying routine mathematical procedures. This proves that students in Indonesia, from elementary to secondary levels, have not been accustomed to solve the complex problems. Hadi (2017) also stated that Indonesian student achievement of grade VIII ranked 34 of 38 countries in TIMSS (Third International Mathematics and Science Study), while in PISA (Program International for Students Assessment), in 2015, Indonesia ranked 63 of 70 countries. From these data, it can be said that Indonesian student achievement still tends to be low.

Making changes for the better is not as easy as saying. It needs a big change that must be done by the mathematics teacher, in particular, in building a discourse into a fact that mathematics is actually fun and close to everyday life. A learning model originating from Freudenthal in the Netherlands since 1971 emerges under the name of Realistic Mathematics Education. This learning model places the reality and experience of students as the starting point of learning. Realistic problems are used as sources for the emergence of mathematical concepts or formal mathematical knowledge.

In addition to the learning model, a teacher must be able to recognize the cognitive style of students so that the teachers can apply the RML model according to students' cognitive style. Thomas (Yasa, Made, Sadra, & Suweken, 2013) suggested that cognitive style refers to the way a person processes information and uses strategies to respond to a task. In other words, the differences of students' cognitive style have an equally important role to understand mathematical concepts and relate them to the surrounding environment. Whereas, according to Keefe (Yasa et al., 2013) stated that cognitive style can be distinguished based on psychological aspects, which consist of field independent (FI) and field dependent (FD).

According to Liu and Ginter (1999) the individuals' characteristics of field dependent in learning are 1) accepting concept and material in general; 2) it is rather difficult to link concepts in the curriculum with their own experience or initial knowledge they already have; 3) like to look for teacher guidance and instruction; 4) requiring a gift or reward to strengthen interaction with the teacher; 5) like to work with others and respect the opinions and feelings of others; 6) preferring to work together rather than work alone; 7) preferring the organization of material prepared by the teacher. While the individuals' characteristics of field independent in learning are 1) focusing on curriculum material in detail; 2) focusing on facts and principles; 3) rarely interacting with the teacher; 4) interacting formally with the teacher is only done to do the task, and tends to choose reward individually; 5) preferring to work alone; 6) preferring to compete; and 7) able to organize information independently.

Learning conditions that allow students who have a cognitive style of field dependent, in order to learn maximally, according to Musser (1997) among others 1) learning in a group or learning in a social environment; 2) clearly and explicitly given more instructions; 3) certain strategies are provided before carrying out an instruction; and 4) more feedback is provided.

The learning conditions that allow students who have maximal learning cognitive style of independent field, according to Musser (1997) include (1) learning that provides a learning environment individually; (2) more opportunities are provided for learning and discovering for themselves a concept or principle; (3) more resources and learning materials are provided; (4) learning that gives little guidance and purpose; (5) prioritizing instruction and goals individually; (6) an opportunity is provided to create a summary, pattern, or concept map based on their thinking.

The objectives of this study are (1) to examine a difference between the learning outcome of students who participate in RML model and expository learning, (2) to examine a difference between the learning outcome of students who have the cognitive style of field dependent and field independent, and (3) to examine an interaction between RML model and cognitive style on students' learning outcome.

2. Method

This research is a quantitative study using two-way experimental design. The subjects of this study are students of religion-based state junior high schools located in Surabaya which are locally identified as MTsN 2 Surabaya and MTsN 4 Surabaya. The sample was taken from the students of Class 8 E and 8 F.

The instrument for collecting data of class 8 E and 8 F cognitive style use Withkin's Group Embedded Figure Test (GEFT). While learning outcome is obtained from instrument that is in the form of test. Before being used for collecting data, the instrument is tested for validity and reliability in other classes.

The data obtained is in the form of 1 dependent variable, namely the learning outcome and 2 factor variables, namely the learning model and cognitive style. After the data has been tested for normality and homogeneity, the hypothesis testing is done by 2-way variance analysis test using SPSS version 22.

3. Results and Discussion

The study was conducted at MTsN 2 Surabaya and MTsN 4 Surabaya. The following is a diagram that shows data of research result based on students' cognitive style.

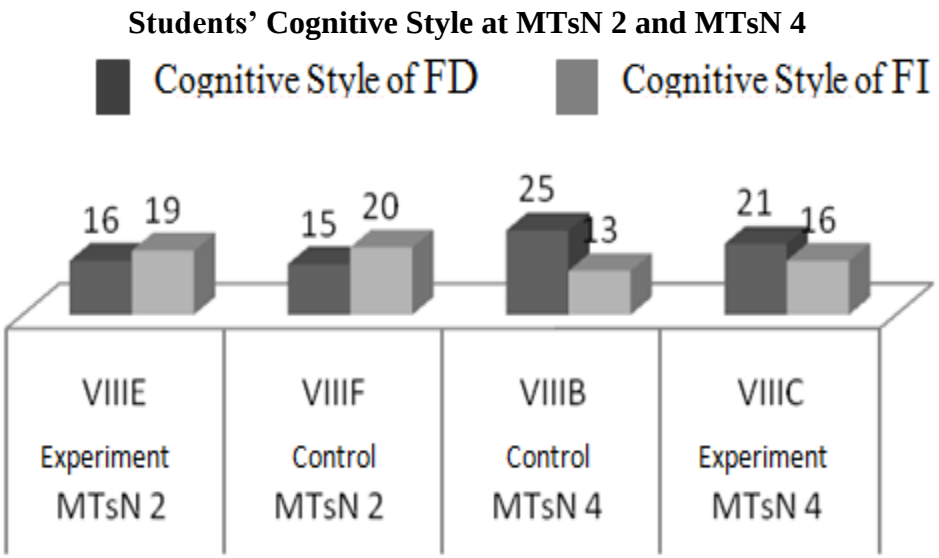

Diagram-1. The Sample Based on Treatment and Cognitive Style.

In the experimental class totalling 72 students, 37 students have the cognitive style of FD and 35 students have the cognitive style of FI. While, in the control class totalling 73 students, 40 students have cognitive style of FD and 33 students have cognitive style of FI.

The following is the statistical data of students' mathematics learning outcome based on the learning model and cognitive style of students.

Table-1. Descriptive Statistics.

Dependent Variable: Learning Outcome				
Cognitive Style	**Model**	**Mean**	**Std. Deviation**	**N**
FD	RML	54.92	9.552	37
	Expository	53.75	10.017	40
	Total	54.31	9.750	77
FI	RML	79.43	7.253	35
	Expository	70.55	9.686	33
	Total	75.12	9.566	68
Total	RML	66.83	14.954	72
	Expository	61.34	12.919	73
	Total	64.07	14.188	145

Table 1 above shows that students' learning outcome treated with model of realistic mathematics learning has an average value of 66.83 with a standard deviation of 14.954. Furthermore, the students' learning outcome treated with model of expository learning has an average value of 61,34 with a standard deviation of 12,919. This means that the average value of students who participate in the model of realistic mathematics learning is higher than students who participate in the model of expository learning with a difference of 5.49.

The students' learning outcome treated with the cognitive style of field dependent (FD) has an average value of 54.31. While the students' learning outcome treated with cognitive style of field independent (FI) has an average value of 74.12. So, it can be concluded that the students' average value treated with cognitive style of field independent (FI) is higher than students treated with cognitive style of field dependent (FD) with a difference in value up to 20.81.

Learning outcome of students who participate in the model of realistic mathematics learning with the cognitive style of field dependent (FD) has an average value of 79.43. While the learning outcome of students who participate in realistic mathematical model with cognitive style of field independent (FI) has an average value of 54.92. So, it can be concluded that the average value of students who participate in the model of realistic mathematics learning with cognitive style of field independent (FI) is higher than students with cognitive style of field dependent (FD), which the difference in value is up to 24.51.

For the hypotheses testing, the data obtained are tested using the test of 2-way variance analysis. The results are obtained as in the following table.

Table-2. Tests of Between-Subjects Effects.

Dependent Variable: Learning outcome					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	16998.300[a]	3	5.666.100	66.638	.000
Intercept	603.203.577	1	603.203.577	7.094.139	.000
Cognitive Style	15.384.031	1	15.384.031	180.928	.000
Model	911.110	1	911.110	10.715	.001
Cognitive Style * Model	536.592	1	536.592	6.311	.013
Error	11.989.010	141	85.028		
Total	624.188.000	145			
Corrected Total	28.987.310	144			

R Squared = .586 (Adjusted R Squared = .578) Source: Taken from data processing by SPSS 22

Table 2 above shows that the significance value for cognitive style is 0.000 <0.05, which means that there is the difference between learning outcome of students who have the cognitive style of field dependent (FD) and field independent (FI). And, the significance value for the learning model is 0.001 < 0.05, which means that there is difference between learning outcome of students who participate in the model of realistic mathematics learning (RML) and expository. While the significance value of the Cognitive Style Model is 0.013 < 0.05, which means that there is the interaction between the learning model and cognitive style on students' learning outcome.

Next, the test results above also show that the value of Corrected Model is 0.000 < 0.05, which means that the model used is valid. Whereas, the R Squared of the data above is 0.586. This value is close to 1, which indicates that the correlation between variables is very strong.

Whereas, to assess whether there are interaction effects between variables, the author gives an overview with a line diagram as shown in the following figure.

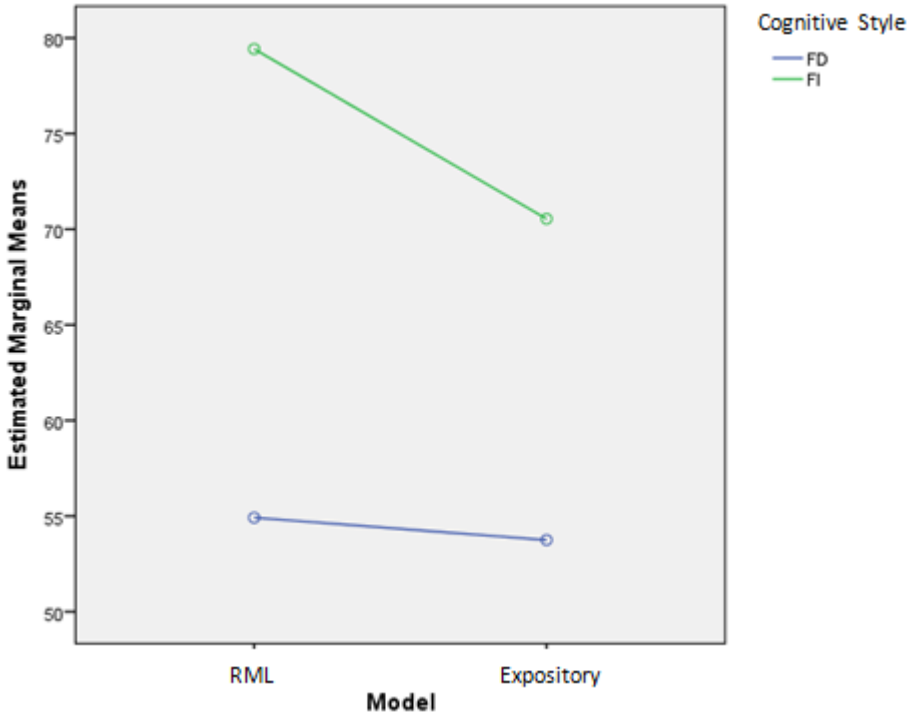

Figure-1. Estimated Marginal Means of Learning.

Figure 1 above is the lines that show misalignment, so that it is suspected that there are interaction effects between variables. So, it can be concluded that there is an interaction between learning model and cognitive style on students' learning outcome.

In the results of the first hypothesis testing, with $F_{count} = 10.715$ and a significance value of 0.001 < 0.05, it means that H_1 is accepted and H_0 is rejected. So that, the results of the study indicate that there is the significant difference between mathematics learning outcome between the students who participate in the

model of realistic mathematics learning and students who participate in model of expository learning in class VIII MTsN 2 Surabaya and MTsN 4 Surabaya.

In the results of the second hypothesis testing, with $F\text{-}_{count} = 180.928$ and a significance value of $0.000 < 0.05$, it means that H_1 is accepted and H_0 is rejected. So that, the results of the study indicate that there is the significant difference between mathematics learning outcome of students who participate in the cognitive style of field dependent (FD) and field independent (FI) in class VIII of MTsN 2 Surabaya and MTsN 4 Surabaya.

In the results of the third hypothesis testing, with $F\text{-}_{count} = 6.311$ and a significance value of $0.013 < 0.05$, it means that H_1 is accepted and H_0 is rejected. So that, the results of the study indicate that there is the interaction between learning model and cognitive style on mathematics learning outcome of class VII students of MTsN 2 Surabaya and MTsN 4 Surabaya.

4. Conclusions

From the results of the explanation above, it can be concluded that: (1) there is the difference between mathematics learning outcome of students who participate in the model of realistic mathematics learning and the students who participate in model of expository learning in class VIII of MTsN 2 Surabaya and MTsN 4 Surabaya, (2) there is the difference between mathematics learning outcome of students who have cognitive style of field dependent (FD) and field independent (FI) in class VIII of MTsN 2 Surabaya and MTsN 4 Surabaya. The students who have a cognitive style of field independent (FI) get a higher score than the students who have a cognitive style of field dependent (FD), (3) there is the interaction between learning model and cognitive style on mathematics learning outcome of class VIII students of MTsN 2 Surabaya and MTsN 4 Surabaya.

Based on the conclusions above, the researcher suggests several things as follow: (1) the model of realistic mathematics learning (RML) can be an alternative learning model in order to improve students' learning outcome, especially in mathematics subjects, (2) a teacher should recognize the characteristics of each student especially cognitive style, so that the teacher is able to apply the appropriate learning model in order to achieve completeness of maximum competency, (3) a teacher must be creative in finding daily ideas or problems that are interesting and able to build a concept that is easily accepted by students, because, basically, every student has had life experience, (4) the results of this study can be developed by other researchers to apply it to other material, even for other subjects.

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