Cognitive Styles and Mathematics Absorption Capacity in Islamic Junior High School

Nuralam
Mathematics Education Department, UIN Ar-Raniry, Banda Aceh, Indonesia

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Abstract: This study aimed at determining of the cognitive styles and mathematics absorption capacity in Islamic Junior High School. This research was conducted at MTsN Model Banda Aceh which consists of 72 respondents, taken randomly by using cluster sampling. The data was collected by using related test techniques, such as cognitive style test with GEFT test and mathematics learning test. Moreover, the analysis data uses descriptive analysis and inferential analysis. The results show that the data on the distributions are normal and homogenous. Based on ANOVA analysis result, the path of mathematics learning outcomes of students who have a cognitive field independent style had a higher score than student's learning outcomes with cognitive field dependent style. This research recommends a teacher to create an effective mathematics learning system by considering the student's cognitive style to optimize the learning mathematics outcome.

1 INTRODUCTION

Renewing or innovating in the field of education on an ongoing basis is one way to improve the quality of Indonesia's human resources. One of the reforms carried out by the government is mathematics education in schools through relevant advanced study programs, efficient and effective training and upgrading, improving curriculum and providing more adequate learning facilities. Quality improvement will create superior Indonesian people to face and to respond to problems in the future.

The quality of mathematics education in school is still very low. This is one of the measurements that of the quality of mathematics learning outcomes is still not optimally reached. Educational achievement in Indonesia is still far below other Asian countries, such as Singapore, Malaysia, Japan, and Vietnam. Based on the data from the World Economic Forum (WEF) which publishes the annual report of The Global Competitiveness Report 2012-2013, which presents data that among ASEAN countries, after Singapore, the highest country competitiveness in 2012 was Malaysia (25th), followed Brunei Darussalam (28th), Thailand (38th). Indonesia is in fourth place with 50th position. In 2012 Indonesia experienced a decline in the global competitiveness index, from the 46th position in 2011 to the 50th in 2012. The comprehensive competitiveness index created by WEF can be a reference to determine the improvements that need to be made (Darwanto, 2012:2)it at so the case of education position in Aceh in 2012 in comparison to other provinces in Indonesia, the quality of education in Aceh was still very low. Based on data released by the Ministry of Education and Culture's National Education Standards Agency (BSNP) in 2012, Aceh Province at the junior secondary level is ranked 21st nationally, while MTs is ranked 26th nationally. In general, it can be said that the passing rate of Aceh Province is still below the national average (Gam, 2012).

The quality of mathematics education in Indonesia is still relatively low in the PISA (Program for International Student Assessment) program which aims atmeasuring students' abilities in the fields of reading, mathematics, and science. Based on the results of the PISA test in 2009, Indonesian mathematics student was found that nearly half of students could not solve on the simple problems, one third of the student could only solve contextual problems and only 0.1% were able to work on mathematical modeling that required thinking and reasoning skills (Wijaya, 2012).

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When viewed from mathematics learning activities at school, the reality is that the teachers are more active than the students. Mathematics learning tends to be teacher-centered thatbring about the students becoming lazy and lack of enthusiasm in mathematics. Learning is no more than delivering information. Consequently,the students easily forget and cannot use math in their lives. Students are being treated as learning objects and the teacher presents more mathematics material with concepts or standard procedures. Accordingly, communication is only one direction in learning mathematics. This condition according to Rusman (2012) reflects the lack of professionalism of teachers and results in students' reluctance to learn. Looking at this condition, in terms of learning technology, the teacher is not able to design mathematics learning well.

A good mathematics learning plan must pay attention to the conditions and choose a suitable strategy in order to improve the quality of learning and certainly will improve students' mathematics learning outcomes. Mathematics learning that is designed must include and analyze all variables that affect learning both theoretically and empirically. According to Reigeluth (1996) there are three components that influence the occurrence of learning behavior, namely learning conditions, learning methods and learning outcomes. Components of learning methods play an important role in determining the quality of learning. For example, the quality of mathematics learning is determined by certain variables and is used as the basis for the teacher's work.

The acquisition of mathematics learning outcomes is influenced by the ability of teachers in recognizing and understanding the characteristics of their students. A teacher who can recognize the characteristics of students will help to learn mathematics that is effective and efficient. Features of students include parts of learning conditions and influence the occurrence of student learning behavior.

Observing the variables of learning behavior above, namely the condition of learning in the form of characteristics of students as the subject of learning, each student has specific features. One characteristic of students who can determine the quality of mathematics learning outcomes and still need research is cognitive style. Cognitive style is related to the way a person receives and processes information. Cognitive style specifically is the characteristic of an individual in receiving and organizing information (Sternberg, 2009).

Based on the description that has been stated, the acquisition of optimal mathematics learning outcomes by paying attention to students' cognitive style. Therefore, it is necessary to study in the form of a study of cognitive style on the learning capacity of mathematics. The formulation of the problem in this study are: (1) Does the cognitive style of students influence student mathematics learning outcomes? and (2) Are there differences in mathematics learning outcomes of students who have independent field cognitive styles and students who have a field dependent cognitive style? The results of this study are theoretically expected to contribute to the learning of school mathematics, especially in the approach to learning mathematics and its relationship to students' cognitive style. Practically the results of this study can be useful for mathematics teachers, students, and researchers in the field of mathematics education.

Cognitive style refers to the way a person processes, stores and uses the information to respond to a task or respond to various types of environmental situations. Referred to as style and not ability because it refers to how someone processes information and solves problems and not refers to how the process of resolution is best. Cognitive style is related to the way a person receives and processes information.

Cognitive style of students plays an important role in the meaningfulness of learning. Hansen (1995) states that cognitive style is described as the way a person obtains information but does not show the content of information but only how the brain perceives and processes information. The same thing is in the opinion of Riding & Rayner (1998) that cognitive style describes the habit of behaving relatively in a person in accepting, thinking about problem-solving, and in storing information. Everyone has a certain way that is relatively consistent in processing information, how to remember, think and solve problems. One type of cognitive style that receives information is field dependent (FD) and field independent (FI). To determine the type of cognitive style of students, whether including the dependent field cognitive style (FD) or the field independent cognitive style (FI), Witkin et al. (1977) have developed an instrument in the form of simple images in a complex pattern called the Embedded Group Test (GEFT).

One cognitive style that influences individual characteristics is the independent field cognitive style. Yousefi (2011) states several characteristics of individuals who have independent field cognitive styles, including: (1) having the ability to analyze to separate objects from the surrounding environment, so that the perception is not affected if the environment changes; (2) has the ability to organize objects that have not been organized and reorganized objects that have been organized; (3) it tends to be less sensitive, cold, maintain distance from others, and individualistic; (4) choose a profession that can be done individually with material that is more abstract or requires theory and analysis; (5) tend to define their own goals, and (6) it tends to work with emphasis on intrinsic motivation and are more influenced by intrinsic reinforcement.

From these characteristics, it can be seen that individuals who have independent field cognitive style have a tendency in stimulus responses using their perceptions and are more analytical. Furthermore Riding& Rayner (1998) describes the learning conditions that allow students who have the maximum independent field cognitive learning style, among others: (1) learning that provides an individualized learning environment; (2) more opportunities for learning are provided and discover for themselves a concept or principle; (3) more resources and learning materials are provided; (4) learning gives little guidance and purpose; (5) prioritizing instruction and goals individually; (6) an opportunity to create a summary, pattern, or concept map based on his thinking. A person with independent field cognitive style tends to state a loose picture of the background of the picture, and is able to distinguish objects from the surrounding context more easily.

In addition to independent field cognitive styles, the cognitive styles which can affect individuals are field dependent cognitive styles. Slameto (2010) clarifies some characteristics of individuals who have a field dependent cognitive style, including: (1) it tends to think globally, view objects as a whole with their environment, so that their perceptions are easily affected by environmental changes; (2) it tends to accept the existing structure because it lacks the ability to restructure; (3) has a social orientation, so that it looks kind, friendly, wise, kind and loving towards other individuals; (4) tend to choose professions that emphasize social skills; (5) it tends to follow existing goals; and (6) it tends to work by prioritizing external motivation and more interested in external reinforcement, in the form of gifts, praise or encouragement from others.

From these characteristics it appears that field dependent individuals tend to respond to a stimulus using environmental conditions as the basis of their perception, and tend to view a pattern as a whole and not separate its parts. A person who has a field-dependent cognitive style receives something globally and has difficulty separating himself from his surroundings.

From the various views above, it can be observed that individuals who have a field dependent cognitive style are individuals who tend to think globally, view objects and their environment as a single, socially oriented, prefer a structured environment, and prioritize motivation and external reinforcement. Individuals with field-dependent cognitive style in learning want are: 1) well-structured learning material, 2) well-structured learning objectives, 3) external motivation, 4) external reinforcement and 5) teacher guidance or guidance.

The hypothesis of this study is as follows: students'mathematics learning outcomes who have independent field cognitive style are higher than students' mathematics learning outcomes who have field-dependent cognitive style.

2 METHODS

This research was conducted at MTsN Model Banda Aceh in 2015. This study used survey research. The populations was all students of Banda Aceh Model grade VIII students who spread to several classes and conducted in the odd semester of 2015. The sample was taken by cluster random sampling technique by selecting classes randomly as experimental class and control class. There are 396 students joined in 11 (eleven) classes in an affordable population were previously randomized to placement in a new class (class VIII). Sampling is done through 2 (two) stages. In the first phase, 4 (four) classes were randomly selected from the sample frame of 11 (eleven) classes. In the second stage, each group is divided into two, namely a group consisting of students who have an independent field cognitive style and a group of students who have a field dependent cognitive style. The students' cognitive style was measured using a cognitive style test instrument in the form of an Embedded Group Test (GEFT) developed by Witkin et al. (1977). As many as 27% of the upper group are expressed as groups that have independent field cognitive styles. While 27% of the bottom group is expressed as a group that has a field-dependent cognitive style. So that the students obtained data as many as 18 students had independent field cognitive style and 18 students who had a field-dependent cognitive style which was spread in 4 (four) groups of students.

Data on mathematics learning outcomes is obtained through instruments made to measure student learning outcomes in mathematics in the form of written tests with objective forms of multiple-choice tests. The validity measurement in this research instrument is Biserial correlation formula, and reliability testing is the KR-20 formula. The results of the research data were analyzed by descriptive analysis and inferential analysis. Data analysis requirements were tested for data normality with Lilliefors test technique. We use the Fisher test and Bartlett test in the homogeneity test of variance. The test results of the analysis requirements show that the data is normally distributed and homogeneous. Research hypothesis testing used one-way ANOVA at a significant level of $\alpha = 0.05$.

3 RESULTS AND DISCUSSION

Descriptive analysis results from the data of mathematics learning outcomes are presented as follows. Data on mathematics learning outcomes of MTs students who have independent field cognitive style as a whole, from 36 students taken as samples obtained scores obtained by students have a range (R) = 11 (spread from 7 to 18). Calculation of descriptive statistics found that the maximum score = 18, minimum score = 7, mean value = 13.111, median = 12.75, mode = 12.00, standard deviation = 3.040 and variance = 9.244.

Table 1. Distribution of frequency of student mathematics learning outcomes that have cognitive style in independent fields.

Interval	F_i	$F_{relative}$
7 - 8	2	5.56%
9 - 10	6	16.67%
11 - 12	9	25.00%
13 - 14	8	22.22%
15 - 16	5	13.88%
17 – 18	6	16.67%
	36	100%

Based on Table 1, it was found that the scores of students' mathematics learning outcomes in the average class were 8 people (22.22%), scores of students under average mathematics learning were 17 people (47.23%), and scores of mathematics learning outcomes above average students were 11 people (30.55%).

Furthermore, the data of mathematics learning outcomes of MTs students who have a field dependent cognitive style as a whole, from 36 students taken as a sample obtained scores obtained by students have a range (R) = 10 (spread from 6 to 16). Calculation of descriptive statistics found that the maximum score = 16, minimum score = 6, mean value = 10.861, median = 10.77, mode = 10.5, standard deviation = 2.497 and variance = 6.237.

Table 2. Distribution of frequency of student mathematics learning outcomes that have cognitive style independent fields.

Interval	F_i	$F_{relative}$
6 – 7	2	5.56%
8 - 9	9	25.00%
10 - 11	11	30.56%
12 - 13	9	25.00%
14 - 15	4	11.11%
16 – 17	1	2.77%
	36	100%

Based on Table 2, it was found that the scores of students'mathematics learning outcomes in the average class were 11 people (30.56%), the score of students' mathematics learning outcomes was below an average of 11 people (30.56%), and the score of mathematics learning outcomes above average students were 14 people (38.88%).

Based on the results of testing the requirements of the analysis in the form of data normality test using Lilliefors Test, it was found that overall of the student data group compared to the L_o price was smaller than the L_t price ($\alpha = 0.05$). This shows that the overall data group of students is normally distributed. Furthermore, the results of the analysis of the requirements of the analysis in the form of variance homogeneity test using Fisher Test on the group of students who have different cognitive styles obtained that the overall price of F is smaller than F_{table} ($\alpha = 0.05$). This shows that the two data groups overall students have homogeneous variances.

A summary of the ANOVAresult in one line of mathematics learning outcomes is presented in Table 3. Based on Table 3, the results of data analysis with one-way ANOVA, it can be explained that the hypothesis testing, students' mathematics learning outcomes that have independent field cognitive style is higher than the mathematics learning outcomes of students who have field-dependent cognitive style. From the calculation results obtained that F_{count} = 11.1 and F_{table} = 3.9 for df = 71 and a significant level of $\alpha = 0.05$ obtained F_{count} greater than F_{table} is 11.1 > 3.9. This means testing the hypothesis rejecting H_0 and accepting H_1, so that the mathematics learning outcomes of students who have independent field cognitive style are higher than the mathematics learning outcomes of students who have field-dependent cognitive style. This can be observed from the average mathematics learning outcomes of students who have independent field cognitive style higher than the average mathematics learning outcomes of students who have a field dependent cognitive style that is $\bar{x}A_1 = 13.1 > \bar{x}A_2 = 10.8$.

Table 3. Summary of one-line ANOVAcalculation results.

Various Resources	**df**	**SS**	**MS**	**F_c**	**F_{table} $\alpha = 0.05$**
Between line (b)	1	71.1	71.1	11.1	3.9
In the group	70	435.6	6.4		
Total correction	71	632.9			

where df: degrees of freedom, SS: the sum of square, MS: mean Squares, F_c: F_{count}.

The hypothesis test results reject the null hypothesis which states that there is no difference in mathematics learning outcomes in groups of students who have independent field cognitive styles and groups of students who have a field dependent cognitive style. So there are differences in learning outcomes between groups of students who have independent field cognitive style and groups of students who have a field dependent cognitive style, namely the mathematics learning outcomes of students who have independent field cognitive style is higher than the mathematics learning outcomes of students who have field-dependent cognitive style.

4 CONCLUSIONS

Based on the hypothesis test, it was found that students'mathematics learning outcomes who had independent field cognitive style were higher than students' mathematics learning outcomes who had a field-dependent cognitive style. This finding identifies that students who have an independent field cognitive style are more successful in learning mathematics.

The choice of appropriate mathematics learning approach by considering the cognitive style of students can optimize mathematics learning outcomes. Research implications that are learning mathematics that teachers need to pay attention to the characteristics of students in learning which in this case is cognitive style. Cognitive style becomes an important factor when the teacher designs mathematics learning and is synergized in the process of learning mathematics in school.

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