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Mathematical Critical Thinking Ability of Students in CTL Learning Based on Cognitive Style

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Abstract

The purpose of the study was to produce a study of the effectiveness of CTL learning on mathematical critical thinking skills and describe students' mathematical critical thinking skills in CTL learning based on their cognitive style. The type of research used is a mixed method concurrent embedded model. The subjects of this study were eighth-grade students of SMP Ekarini Semarang. Retrieval of data in the form of cognitive style using the GEFT test and mathematical critical thinking skills through tests. The results of analysis of individual completeness data using one sample t-test sign value 0.588> 0.05, classical completeness with test proportion z count = 1.67> z table = 1.64, and simple linear regression test with the help of SPSS produces a sign value of 0,000 <0,005 with R^2 = 0.684 which means that the application of effective CTL learning to mathematical critical thinking skills and cognitive style has an influence on mathematical critical thinking skills of 68.4%. The cognitive style of FDI has the best mathematical critical thinking ability by mastering the ability in aspects of conclusions, assumptions, deductions, and interpretations. The cognitive style of FI masters the ability in aspects of conclusions, deductions, interpretations, and evaluate arguments. The cognitive style of FD controls the ability to draw conclusions, assumptions, and deductions. Educa need to pay attention to the application of learning that can be received by all students despite having different styles such as cognitive the CTL models.

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INTRODUCTION

Indonesia is a country that adheres to the national education system. The aim of national education according to Law number 20 of the National Education System in 2003 is to develop the potential of students to become human beings who believe and devote to God the Almighty, have a noble character, are healthy in knowledge, capable, creative, independent, and become responsible and democratic citizens. The purpose of mathematics learning in schools according to the Ministry of National Education (2004) are: (1) to practice thinking and reasoning in drawing conclusions, (2) to develop creative activities that involve imagination, intuition, and discovery by developing divergent, original, curiosity, make predictions and predictions, and experiment, (3) develop the ability to convey information and communicate ideas. Thus, mathematics as part of the basic education curriculum plays a strategic role in improving the quality of Indonesia's human resources.

Mathematics as a scientific discipline that clearly relies on thought processes is considered very good to be taught to students. In mathematics learning contains various aspects that substantially require students to think logically and critically according to the patterns and rules that have been arranged in a standard. Especially critical thinking is very necessary for their lives in order to be able to filter information, choose whether or not a need is needed, question the truth, and solve problems in everyday life.

SMP Ekarini is one of the schools that implemented the 2013 KTSP curriculum. Based on observations it is known that the average ability of the 8th-grade students of SMP Ekarini is in a low category because students have difficulty in reviewing the problems presented, searching, and choosing the right solution. The learning process is still focused on the practice of solving questions that are procedural and mechanistic rather than understanding. When students are given the opportunity to present in front of the class, students simply write down the answer without explaining the completion steps and the reason for choosing the solution. The problems experienced by these students relate to mathematical critical thinking skills. In fact, the mathematics material in the 2013 KTSP curriculum requires students to have good mathematical thinking skills to be able to solve the problems given and face national exam questions in class IX later.

Critical thinking is a directed and clear process used in mental activities such as solving problems, making decisions, persuading, analyzing assumptions, and conducting scientific research (Johnson, 2009: 185). Critical thinking ability is the ability of students in reasoning based on logic towards a reality (Pusporini, Ahsadi, and Sarwanto, 2012: 34). Students with critical thinking skills are able to process information, then analyze it, evaluate it, reason with logic then be able to communicate their reasoning well.

One of the characteristics of students that must be considered in choosing and implementing a learning model and achieving learning outcomes is the difference in cognitive style. Cognitive style is closely related to the way and attitude of students in learning. In learning, educators are required to be able to assess the type of cognitive style of students, then choose and apply a learning model that is in accordance with the different cognitive styles of the student. The cognitive style put forward by psychologists and education is the cognitive style of Dependent (FD) and Field-Independent (FI) styles. Students who have a Field Independent cognitive style generally tend to process the information they receive, whereas students who have a Field Dependent cognitive style generally tend to receive the information (Ardana, 2008: 76).

The model that is expected to be good for applying to mathematics learning and in order to stimulate the emergence of mathematical critical thinking skills of students related to the cognitive style of each student is the Contextual Teaching and Learning (CTL) model. CTL learning is a learning concept that helps educators to associate the material taught with students' real situations and encourages students to make connections between the knowledge they have and their application in daily life (Rifa'i and Anni, 2009: 236). The CTL model consists of four

stages, namely invitations, exploration, explanations and solutions, and taking action..

METHODS

This type of research is a mixed method concurrent embedded model research. Research held in class VIII SMP Ekarini Semarang semester of the school year period 201 8/201 9. The research activity begins with determining the type of cognitive style by using the GEFT test. Furthermore, students are subject to CTL learning the SPLDV material was conducted for four meetings. At the end of the learning activity, students are given a test of mathematical critical thinking skills and conducted interviews. For each type of cognitive style taken at least 2 students as research subjects. Determination of the subjects was also held balance the types of cognitive style, critical thinking ability of students' mathematical, and can express their opinions well in order to support the implementation of the research.

The instruments used in this study were the researchers themselves, GEFT Test, Mathematical Critical Thinking Ability Test, and Interview Guidelines. Quantitative data analysis was obtained from the results of the Mathematical Critical Thinking Ability Test. The quantitative analysis used is an individual completeness test assisted by SPSS with one sample t-test, classical completeness test using proportion test, influence test using simple linear regression test. While the qualitative data analysis was obtained from the GEFT test results and interviews.

RESULT AND DISCUSSION

In this study, mathematical critical thinking skills are described based on cognitive style scores in the research sub-section consisting of 6 students in different categories. GEFT test results showed 22 students from grade VIII, as many as 14 students have cognitive style FD, 4 students have cognitive style FI, and 4 other students have cognitive style FDI.

The FD category has the most number, as much as the FDI and FI categories have the same amount. This is because students are not yet accustomed to working and completing tasks independently. The grouping of students based on their Cognitive Style can be seen in the following table.

Table 1. Student Order Table Based on Cognitive Style

No	Student Code	Total	Information
1	WA	3	FD
2	RA	4	FD
3	YP	4	FD
4	SY	5	FD
5	DP	6	FD
6	AD	7	FD
7	MJ	7	FD
8	FI	7	FD
9	AE	8	FD
10	LY	8	FD
11	MR	8	FD
12	FK	8	FD
13	DA	9	FD
14	RD	9	FD
15	GF	10	FDI
16	NC	10	FDI
17	SD	12	FDI
18	KA	13	FDI
19	CD	14	FI
20	AF	14	FI
21	BP	15	FI
22	DS	16	FI

Based on the table above, the study subjects selected in this study were WA and RA who have FD Cognitive Style, NC and SD who have Cognitive Style FDI, and BP and DS who have FI Cognitive Style. The next step after determining the subject is that students are subject to CTL learning.

The CTL learning stage consists of invitations, exploration, explanations, and solutions, and action taking. At each stage, students are encouraged to develop critical mathematical thinking skills ranging from aspects of conclusion, assumptions, deductions, interpretations, and evaluation of the arguments that

have been presented. All aspects of critical thinking are carried out both in solving the questions and the class discussion process takes place.

In the conclusions aspect, the results show that FD subjects have good conclusions. This can be seen from the steps taken to complete. FD subjects can describe in detail about the stages of the solution to the problems presented. Based on the sample work, the FD subject can make a mathematical model of the problem given and make a settlement with coherent steps.

However, Subject FD is less able to master the aspects of the recognition of the assumptions (Assumptions) and deductions (deductions). Based on the results of FD Subject work, aspects of recognition of assumptions and deductions can state the right or wrong answers, but cannot provide a good explanation of the answers that have been chosen. However, FD subjects verbally can provide reasons for the answer to their work if given questions related to the completion of the given question.

The value of the test of critical thinking skills mathematically FD students with WA code is 26 and the RA code is 32. FD subjects can only solve a few questions given because of difficulties in interpretation and evaluation arguments. Therefore, the critical thinking skills of FD subjects in these two aspects are still weak.

The FDI subjects selected in this study were SD and NC. The GEFT scores obtained are 12 and 10. The following is a more detailed explanation of the critical thinking skills of FD subjects.

In the aspect of conclusions, the results show that the subject of FDI has the ability to draw good conclusions. This can be seen from the steps taken to complete. FDI subjects can describe in detail the stages of the solution to the problems presented. Based on the sample work, the subject of FDI can make a mathematical model of the problem given and make a settlement with coherent steps.

The ability of FDI Subjects in terms of assumptions, deduction, and interpretation is also quite good. Based on the results of the FDI Subject work, the deduction aspect can state the right or wrong answer with a good explanation of the answers that have been chosen. FDI subjects verbally can provide reasons for their job answers if given questions related to the completion of a given question. Meanwhile, the ability to think critically on subject FDI in the evaluation argument aspect is still not good because of the difficulty in making decisions and communicating the reasons for the arguments chosen. However, if given reinforcement or questions that lead to arguments, then the subject of FDI can describe the answer well.

The values obtained by both FDI subjects are 80 and 82. Thus, the highest scores of critical mathematical thinking ability tests are obtained by subjects with FDI cognitive styles.

FI subjects are subjects who have the highest GEFT score. The GEFT score obtained by FI subjects is 15 and 16. The following is a more detailed explanation of the critical thinking skills of FI subjects.

Subject FI capability in aspects of deductions (deductions), interpretation, and evaluation is also a good argument. Based on the results of the FI Subject work, the deduction aspect can state the right or wrong answer with a good explanation of the answers that have been chosen. Meanwhile, the ability to think critically of FI subjects in the aspect of assumptions is still not good because it is still often wrong in making choices.

The values obtained by both subjects of FI are 74 and 78. The value obtained by FI subjects is lower than that of FDI because in the process of teaching and learning the subject of FDI is more active than the subject of FI. If in the completion of the task or the questions given experience difficulties, then the subject of FDI does not hesitate to ask friends who are considered to have mastered the material or the teacher concerned.

Quantitative data analysis is done by using influence test to determine the effect of independent variables, namely cognitive style (X 1) on the dependent variable, namely students' critical thinking skills in CTL (Y) learning. To test this effect used simple regression test aided by SPSS produces an output sign = 0.000 <0.05 means that H 0 is rejected. So, the cognitive style has a positive effect on mathematical critical thinking skills. The magnitude of the influence can be seen from the value. This

value shows that cognitive style has a strong influence on mathematical critical thinking ability by 80%. This is because the cognitive style is the way a person understands, processes, stores and uses the information to respond to a task or information. In this study students 'cognitive style is very instrumental in developing students' critical thinking skills.

The cognitive style of FDI produces the highest score compared to other cognitive styles because the subject of FDI has the courage to ask friends or teachers if they have difficulty completing their assignments. In addition, the subject of FDI is also active during the teaching and learning process both when the teacher explains the material and group or class discussion.

Meanwhile, for FD subjects it is rather difficult to connect concepts independently so that it requires extrinsic reinforcement to be able to complete its tasks. The subject of FD takes longer in the satisfaction of a concept or material. This causes FD subjects to be in the group under the acquisition of mathematical critical thinking test scores.

The FI subjects are students who are independent and tend to be individual in completing their tasks so that they will try their best to solve the problems given with their own abilities. Students who fall into this category rarely interact with friends or teachers. When the teacher gives material reinforcement, the FI subject will receive and process the information received to further discover the concept itself. This is what causes the FI subject to testing the critical thinking ability lower than the FDI subject.

Based on the results of FD Subject work, aspects of recognition of assumptions and deductions can state the right or wrong answers, but cannot provide a good explanation of the answers that have been chosen. However, FD subjects verbally can provide reasons for the answer to their work if given questions related to the completion of the given question.

The test scores of mathematical critical thinking skills of FD subjects are low. This is caused by FD subjects can only solve a few questions given because of difficulties in interpretation and evaluation arguments. Therefore, the critical thinking skills of FD subjects in these two aspects are still weak. FD subjects are less independent and need reinforcement assistance in carrying out their duties. Another obstacle faced by FD subjects is the difficulty in linking new concepts that are accepted with pre-existing concepts. This causes some aspects of mathematical critical thinking cannot be done well.

The subject of FDI in the aspect of withdrawal shows good ability. This can be seen from the steps taken to complete. FDI subjects can describe in detail the stages of the solution to the problems presented. Based on the sample work, the subject of FDI can make a mathematical model of the problem given and make a settlement with coherent steps. The ability of FDI Subjects in terms of assumptions, deduction, and interpretation is also quite good. Based on the results of the FDI Subject work, the deduction aspect can state the right or wrong answer with a good explanation of the answers that have been chosen. FDI subjects verbally can provide reasons for their job answers if given questions related to the completion of a given question. Meanwhile, the ability to think critically on subject FDI in the evaluation argument aspect is still not good because of the difficulty in making decisions and communicating the reasons for the arguments chosen. However, if given reinforcement or questions that lead to arguments, then the subject of FDI can describe the answer well.

The highest value of a mathematical critical thinking ability test is obtained by subjects with FDI cognitive style. This is because the subject of FDI has the will to interact with friends and teachers so that when they experience difficulties in completing their tasks, the subject of FDI does not hesitate to ask those who know better. In addition, the subject of FDI also has independence in carrying out tasks that it has mastered well. The ability to think critically is increasingly honed because the subject of FDI likes to work in discussion groups so that they can exchange ideas or information to reinforce the concepts they learn.

FI subjects are subjects who have the highest GEFT score. However, the value obtained by FI subjects is lower than the subject of FDI because in

the process of teaching and learning activities the subject of FDI is more active than the FI subject. In completing assignments or questions given FI subjects tend to be individualistic and try to find information independently. The ability of FI subjects in the aspects of deduction, interpretation, and evaluation argument is very good. However, the assumptions aspect is still lacking because it is often mistaken in making choices. FI subjects can provide a detailed and logical explanation in the steps of completion, although not in a coherent manner.

Based on the description above, it can be concluded that the most cognitive style for developing students' critical thinking skills is the cognitive style of FDI. This is because there is a balance between new concept connectivity and the concept that has already been received. The positive style of FDI is able to interact well in groups so as to strengthen the concepts it has mastered. The active subject of FDI during the teaching and learning process adds matured material to be studied. Therefore, the ability to subject FDI in solving critical thinking problems is better than other subjects.

CONCLUSION

Based on the description above it can be said that the application of CTL learning is effective against mathematical critical thinking skills in terms of the cognitive style of students. Student groups with a cognitive style of FDI have good critical thinking skills in aspects of conclusions, assumptions, deductions, and interpretations. Student groups with the cognitive style FI have good critical thinking skills in aspects of conclusions, deductions, interpretations, and evaluate arguments. Student groups with cognitive style FD have critical thinking skills that are good at aspects of conclusions, assumptions, and deductions.

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