Students' Critical Thinking Depends On Their Cognitive Style

Muhammad Noor Kholid, Paras Sukma Hamida, Lingga Nico Pradana, Swasti Maharani

Abstract: Problem solving in mathematics is something that can not be separated from the ability to think critically. Whereas critical can be influenced by cognitive style. This study describes the students' critical thinking character in mathematics problem solving in terms of cognitive style. Data was collected using test techniques, observation notes, interviews, and video recordings. Subjects included were 7th grade students of MTs Agung Alim Blado Indonesia. The number of subjects was 4 students, consisting of 2 students with Field Independent cognitive style (FI) and 2 students with Field Dependent (FD) cognitive style. The results showed differences in critical thinking skills between FI subjects and FD subjects. Subjects FI fullfil all of the critical thinking aspects such as interpretation, analysis, evaluation, inference, explanation, and self regulation. Subjects FD only fulfill a number of indicators in critical thinking aspects.

Index Terms: questions, critical thinking, independent fields, dependent fields.

1. INTRODUCTION

Basically critical thinking depends on two dispositions [1]. First, the effort to be able to do something right, say honestly, and clearly to convince someone about their answera. Second, it depends on the evaluation process that is applied to determine the criteria in assessing the possibility of correct answers that will appear both explicitly and implicitly. Research earlier that focuses on critical thinking conclude several things. First, in the process of learning mathematics, critical thinking is an important component that students must have. This is intended so that students are able to formulate, identify, interpret and plan problem solving [2]. Second , in solving a problem, critical thinking is an individual thought process to make or draw conclusions from known information [3]. In addition there are previous studies that focus on cognitive styles that conclude several things. First, humans' tendencies in obtaining , processing, and organize information and present this information again based on experience possessed its called conitive style [4]. Second, cognitive style usually also describes a personality dimension that influences the attitudes, values and social interactions of each individual. However, there are no studies that reveal students' critical thinking in terms of the cognitive styles of Independent Field (FI) and Field Dependent (FD).

Development of education in a country can be seen through the results of the Program for International Student Assessment (PISA). PISA focuses on mathematics, science, and reading. When viewed from the results of PISA, Indonesia's position is ranked 62 out of 70 Countries in the World that follow PISA. The average math score achieved by Indonesia is 386, while the international average score is 490. It means the average math score of students in Indonesia is still below average. The low average value can be influenced by differences in critical thinking skills possessed by each student . The ability to think critically can be influenced by cognitive styles [5]. Cognitive styles is fundamental to distinguish between individuals as long as they interact with elements of the situation, and also an important approach to understand and personally think [6]. Cognitive style is one of the psychological factors related to learning which is described as stability and personality that influence attitudes, values, and social interactions. Witkin categorizes cognitive styles into two Field Dependents (FD) and Field Independent (FI) [7]. This study aims to analyze character of critical thinking based on aspects of interpretation, analysis, evaluation, inference, explanation and self-regulation in MTS Alim Blado with cognitive style FI and FD. Furthermore, the research question that will be answered is how the character of critical thinking students of MTS Agung Alim Blado with cognitive style FI and FD. This study provides a spark plug contribution to the literature in terms of: 1) helping students to know what type of cognitive style they have and the extent of students 'critical thinking skills in solving problems, 2) considerations for improving and honing students' critical thinking skills in solving problems, and 3) add to the learning experience with critical thinking skills in terms of students' cognitive styles. Human who conduct critical thinking is an individual who is able to act and think normatively, and able to judge the quality of what they see, hear, or what they think [8]. Critical thinking is really needed by every individual in facing a problem that exists. Where in solving a problem every individual (especially students) must be able to compete in a healthy and fair manner, and be able to create a feel of good cooperation with others. Critical thinking is thinking is reflective and has grounds were focused on when taking a decision on what action should be performed [9]. Aspect of critical thinking including interpretation, analysis, evaluation, inference, explanation, and self regulation [10] . The indicators are described in the following Table 1.

Table 1. Indicators of Critical Thinking

Aspect	Characteristics/Indicators
Interpretation	Read the problem given.
	Pay attention to the problems given.
	Describe the problem given.
	Write the information that is known and asked in the problem.

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Analysis	Choose the method used to solve the problem given based on prior knowledge.
	Write down what needs to be done in the problem / solution correctly .
Evaluation	Substituting known information into the formula.
	Re-examine the answer to the problem given before making conclusions.
Inference	Make conclusions on the answers.
Explanation	Give reasons for answers and conclusions drawn.
Self Regulation	Re-examine the answers and conclusions written

Each individual has a different cognitive style. Cognitive style on students assessed can affect the process of critical thinking and learning outcomes in students. Cognitive style is an individual's way of making and organizing perceptions about the knowledge that is around him [11].

2 RESEARCH METHODS

2.1 Design

This research is a qualitative research. Qualitative research method is a research method that relies on the philosophy of positivism. The design used in this research is descriptive design. Descriptive research is research that aims to give pictures, or describe the state of an object (reality or phenomenon) in accordance with the situation and conditions at the time the research was conducted as it is [12].

2.2 Participants

The subjects in this study were 7th grade students in MTS Agung Alim Bado Indonesia in 2019, totaling 99 students . Research subjects were selected through GEFT test results and interviews with teachers. Obtained information from the calculation data as many as 38 students have the type of FI cognitive style and 61 students have the type of cognitive style FD. Based on the results of the cognitive style categorization, each of the 2 students was chosen to be the research subject. Subject S1 and S2 categorized into FI, while S3 and S4 categorized into FD

2.3 Instruments

The instruments in this study are: 1) GEFT test, 2) 1 item test questions, 3) observation notes, and 4) interview guidelines to confirm students during problem solving.

2.3 Data Collection Technique

Researcher used interviews, tests, video recordings, and field notes. The GEFT test instrument is used to categorize students with the cognitive style types FI and FD. While the test instrument used to see students' critical thinking skills in solving problems. The validity of the data obtained through the triangulation of techniques carried out in this study compares the results of students' GEFT with the results of student work in solving problems given by researchers, with video recordings, interviews, and the results of observation notes. The validity of the questions in this study uses content validity. Content validity testing is done by requesting expert judgment regarding the suitability of the questions to be given to the research subjects [13].

2.4 Data Analysis

Data analysis in this study includes data reduction, data presentation and conclusion. Data collection can be presented in the diagram in Figure 1.

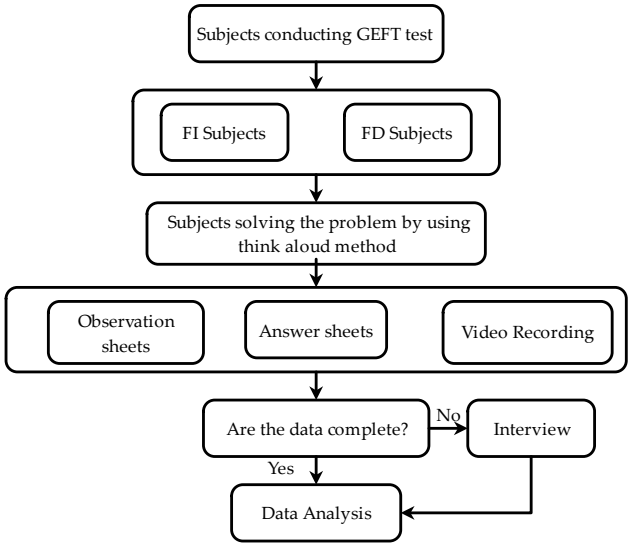

Figure 1. *Data Collection Flow Chart*

3 RESULTS AND DISCUSSIONS

The results showed differences in critical thinking skills between FI (Subject S1 and S2) and FD (subject S3 and S4). Subjects FI fulfill all the characteristics in the critical thinking indicators. Whereas FD did not fulfill all the characteristics in the critical thinking indicators.

3.1 Interpretation Aspect

S1 and S2 read the problem given, write all known and asked information in the problem. The results of a study conducted showed that subject FI had a deeper ability to understand questions [14]. So that subjects FI are able to write down what is known and asked clearly and correctly. Another indicator fulfilled by the FI subject is describing the problem given. This can be seen from the results of the work of the subject S2 in Figure 2 .

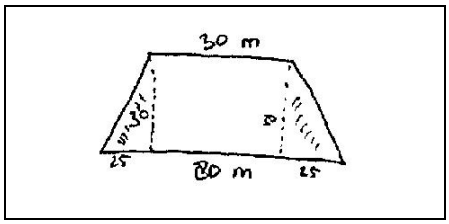

Figure 2 . *S2 illustrates the problem given*

In solving the problem there are slightly differences in the fulfillment of the indicators of the subjects S3 and S4. S4 only fulfills one characteristic, which is reading the given problem. S3 also reads the problem given and illustrates the problem given. However, there are other characteristics that are fulfilled by subject S3, namely describing the problem given. This can be seen from the results of the work of the subject S3 in Figure 3.

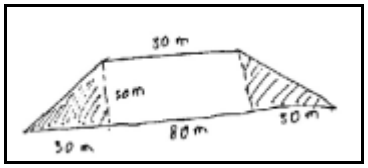

Figure 3 . *S3 illustrates the problem given*

Based on the results of interviews with S4, information was obtained that S4 did not describe the problem given because there were no commands/instructions to illustrate the problem into a picture. In line with the results of the study, the results show that subject FD tend to need clearer instructions or instructions on how to solve problems [15].

3.2 Analysis Aspect

Subject S1 and S2 choose the means used to resolve a given problem based on knowledge gained previousl . This can be seen from the results of interviews and the results of FI's answer sheet. In addition, the subject of FI also wrote down the answers appropriately according to the solution determined by the researche . This can be seen from the results of the work of FI subjects in Figure 4 . In line with the results of the study, the results showed that students with the Field Independent cognitive style were able to plan up to carry out plans very well [16].

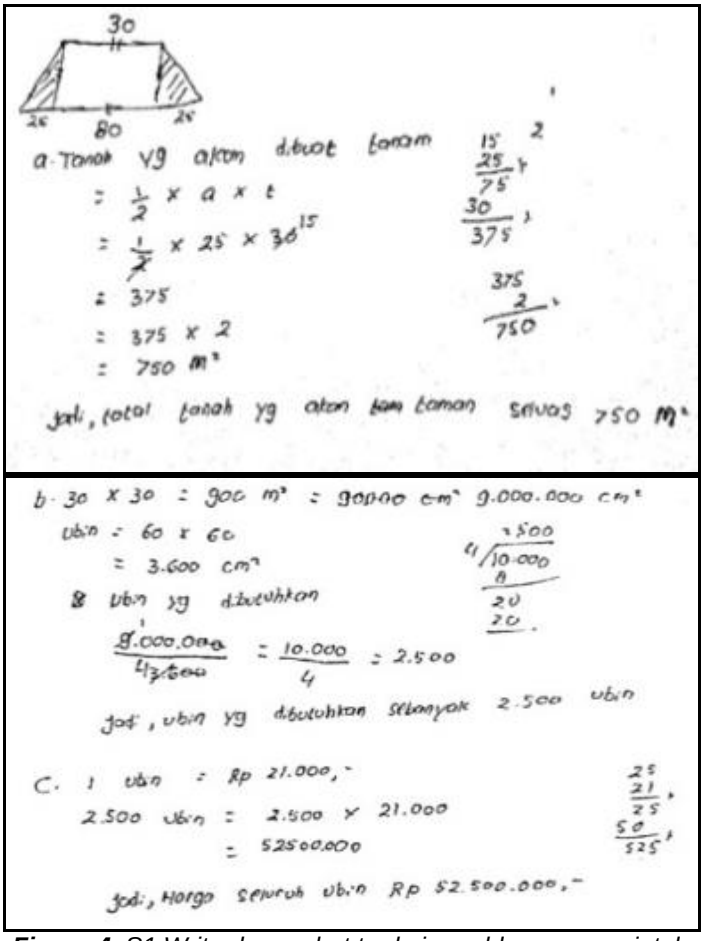

Figure 4*. S1 Write down what to do in problem appropriately*

Based on the results of the interviews and the results of the work of the FD subject , the FD subject chooses the method used to solve the problem given based on prior knowledge. Following are the results of the work on the FD subject in Figure 5. The subject of FD did not meet the characteristics of writing the answers correctly according to the solution determined by the researcher. The results showed that subjects FD often gave incorrect answers [17].

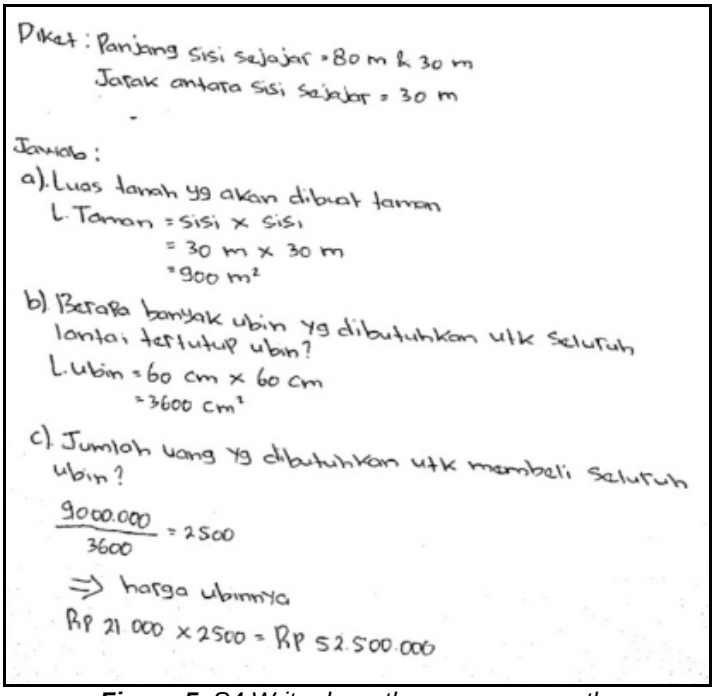

***Figure 5**. S4 Write down the answer correctly*

3.3 Evaluation Aspect

The FI subject substitutes known information into the formula. This is seen from the observations of researchers when thinking aloud. In addition, the subject of the FI also checks the answers to the problems given before making conclusions. In line with the results of the study, the results showed that students with the FI cognitive style were able to understand a problem well, in addition FI was also able to process information well [18]. Based on the observations of researchers when thinking aloud and the results of interviews, the subject of FD substitutes known information into the formul . However, subjects S3 and S4 did not re-examine the answer to the problem given before drawing conclusions. In line with the results of the study, the results show that subject FD tend to be less able to check back and write the conclusions of the answers correctly [16].

3.3 Inference Aspect

The FI subject made a conclusion on the answer. This is also supported by quotations from S1 statements during problem solving through think aloud.

" . . . . (rechecking answer a), so the total land that will be made into a garden area of 750 square meters (writing)"

In line with the results of the study, the results also showed that subjects FI were able to draw conclusions with appropriate solutions [16]. Based on the observations of researchers and the results of FD subject answer sheet, the FD subject does not make conclusions on the answers. Here are the results of the FD subject's work in Figure 6.

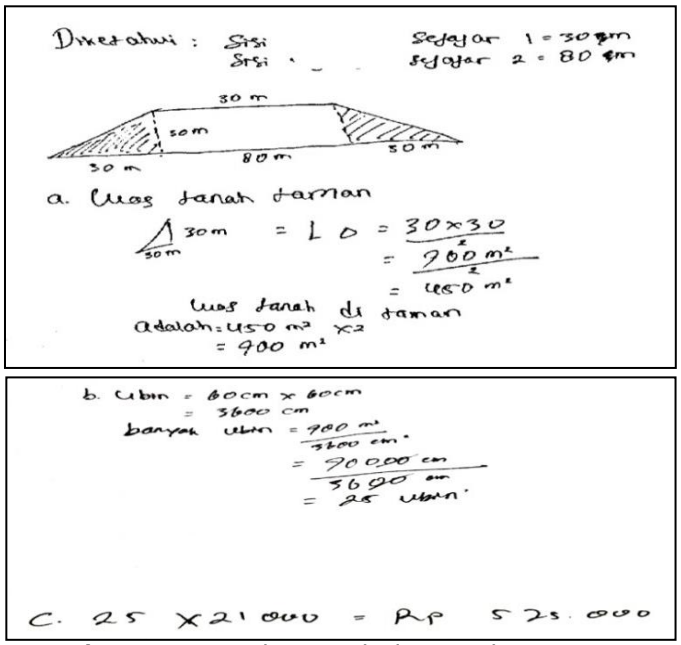

***Figure 6 .** S3 makes conclusions on the answers*

The FD subject does not meet the characteristics of making conclusions on the answers . In line with the results of the study, the results showed that subjects FD were unable to draw conclusions that were in accordance with the facts [19].

3.5 Explanation Aspect

Based on the results of the interview, after solving the problem S1 and S2 subjects provide reasons for the answers taken. In line with the results of the study, the results showed subject FI had a firm and confident attitude towards their opinions[7]. Based on the results of the interview, after problem solving the subjects S3 and S4 provide reasons for the answers taken. However S3 and S4 are not sure of the answers written . Subjects FD had an attitude that lacked confidence in their opinions[6].

3.6 Self Regulation Aspect

Based on the results think aloud and interviews, the subject S1 and S2 m emeriksa returned written answers. In line with the results of the study, the results show that subjects FI re-examine solutions that have been implemented clearly, precisely, thoroughly, logically and relevant to the problem [20]. Based on the results think aloud and interviews, the subject S3 and S4 rechecked their answers. The results showed that subjects FD rechecked their answer even though they often did not get the correct answers [17].

4 CONCLUSION

Based on the results of the research that has been done and the discussion that has been explained, conclusions can be drawn about the students' critical thinking skills in terms of cognitive style in solving the problem of the VII grade students of MTs Agung Alim Blado in the following Table 2 .

***Table 2**. Conclusion of students' critical thinking skills in terms of the cognitive style of FI and FD*

	FI subject	FD subject

Interpretation	The FI subject reads the problem given, pays attention to the problem given, describes the problem given, and writes information that is known and asked about the problem.	FD read the problem given and describe the problem given .
Analysis	Subject FI choose the means used to resolve a given problem based knowl knowledge obtained previously and m enuliskan what to do in the issue / settlement appropriately.	Subject F D choose to use prior concept in solving problem.
Evaluation	Subject FI m ensubstitusikan informa the known into the formula and m emeriksa back the answer from the given issue before making a conclusion .	Subject FD able to subtitute the information given in the formula
Inference	Subject FI write conclusions on the answer	Subjects FD do not not make conclusions on the answers.
Explanation	Subject FI give the reason in their answer	Subjects FD do not give the reason
Self-Regulation	Subject FI recheck the step and the answer.	Subjects FD do not not recheck the answer

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