Analysis of Student's Epistemic Cognition in Solving Mathematical Problem Viewed from Field Independent and Field Dependent Cognitive Style

Abstract. An individual's understanding of the process of acquiring knowledge and manipulate knowledge through the activity of remembering, analyzing, judging, reasoning, and imagining called cognition. The process of cognition when people face the problem consists of three levels, namely cognition, metacognition, and epistemic cognition. Epistemic cognition students in solving mathematical problems can be influenced by many factors, one of which is cognitive style. Therefore, this study aimed to describe: (1) epistemic cognition students with field independent cognitive style in solving mathematical problems, (2) epistemic cognition students with field dependent cognitive style in solving mathematical problems. This research is a descriptive qualitative approach. Sampling was conducted using purposive sampling technique. The subjects used in this study as many as four students: two students with field independent cognitive style and two students with field dependent cognitive style. Data collection techniques used in this study isclassification tests of cognitive style,problem solving test and interview.Tests of cognitive style classification, Problem solving tests and interviews were analyzed based on indicators of epistemic cognition students in solving mathematical problems. Based on the analysis and test results performed instrument, the epistemic cognition obtained by students with cognitive style field independent and field dependent in solving mathematical problems.

Keywords: epistemic cognition, problem solving, cognitive style.

1. Introduction

Mathematics is one of the subjects that has become a benchmark of success in developed countries, up to now 60% - 80% rely on mathematics. Therefore it is necessary to make efforts to improve and develop the quality of education to be better, especially in developing mathematical knowledge. One

that influences the development of mathematical knowledge in Indonesia is teacher competence in providing knowledge and learners in receiving knowledge. According to Widodo (2016), individuals understand the process of gaining knowledge and manipulate knowledge through activities of remembering, analyzing, judging, reasoning, and imagining what is called cognition. The process of cognition when individuals face problems consists of three levels stated by Kitchener (1983), namely cognition, metacognition, and epistemic cognition.

According to Widodo (2016), Epistemic cognition is a cognition of knowledge, the process of gaining knowledge and justification of knowledge. Epistemic cognition of students can be known when students solve problems. Based on Muis (2009), the individual epistemic level in solving mathematical problems is influenced by several factors, namely metacognition strategies (planning, monitoring and control), mathematical problem solving approaches (empirical and rational approaches), justification of mathematical problem solving. The diversity of epistemic cognition of students in solving mathematical problems can be influenced by many things, one of which is cognitive style. According to Woolfolk (2001), it has been suggested that cognitive style is a form of different ways how students understand and regulate information. Every individual will never be separated from the influence of cognitive style when studying information. According to the explanation of cognitive style psychologists, namely Jonassen and Grabowski, as outlined by Ghinea & Chen (2006) based on differences in psychology there are two classifications of cognitive styles, namely Dependent Field (FD) and Field Independent (FI). Individual FD is a type of individual who thinks globally and tends to be passive, while individual FI is an individual type who understands and processes information analytically. Each individual must have a different background in cognitive style, so that the information processing when analyzing problem solving will also be different according to his cognitive style perspective.

Therefore this study aims to describe: (1) epistemic cognition of students with cognitive field independent style in solving mathematical problems, (2) epistemic cognition of students with cognitive field dependent styles in solving mathematical problems.

2. Research Methods

The type of research used in this study is descriptive research with a qualitative approach, where data is analyzed in the form of qualitative data and described to produce an indepth picture of the epistemic cognition of students in mathematical problem solving in terms of field independent and field dependent cognitive styles.

The subjects in this research were VII grade students of MTs Tropodo Krian. The sampling technique used was purposive sampling (sampling techniques from data sources with certain considerations). The researcher took 4 subjects consisting of 2 students who had a field dependent cognitive style and 2 students who have a cognitive field independent style. Data collection in this research is in the form of data qualitative, the results of the *Group Embedded Figure Test* (GEFT), the test results problem solving abilities, and results interview.

2.1. Group Embedded Figures Test (GEFT)

This instrument consists of 2 groups of questions. The two question groups consisted of 9 items. Each was given a score of 1 if answered correctly and a score of 0 if the answer was wrong, so the maximum score was 18 and the score was at least 0. The time given for the two groups of questions was 18 minutes. In determining the group of respondents classified as cognitive field dependent or field independent, a category was used in which scores 0 to 11 were categorized as FD groups and scores 12 to 18 were categorized as FI groups. For this study FD students were selected whose scores were close to 0 and FI students were selected with a score close to 18.

2.2. Test of Problem Solving Abilities

The problem solving ability test instrument is in the form of a description question which aims to obtain data about the students' mathematical problem solving process with detailed steps in accordance with the abilities and knowledge of each student. The problem solving ability test consists of 2 items arranged in accordance with the existing curriculum. In this study the question will be validated by the validator in order to assess whether the material and language used meet the criteria valid or not. After being declared valid by the validator, the question will be given to the research subject.

2.3. Interview

Subjects selected were interviewed based on interviews guidance to gain information of students' strategies. The result of data analysis was done by data reduction, data display, and conclusion.

3. Results and Discussion

This research was done in seven grade MTs Tropodo Krian on Tuesday, 2nd April 2019 for GEFT and Thursday, 4nd April 2019 for tests of problem solving ability and interviews. This research was conducted on mathematics lessons during one lesson (40 minutes). The selection and use of this hour is done with permission from the subject matter teacher concerned.

3.1. Result of GEFT

From the results of the analysis of filling the GEFT instrument, the following data are obtained:

Table 1. Cognitive Style VII grade students of MTs Tropodo Krian

Cognitive Style	Many Students
Field Dependent	14
Field Independent	6

Based on Table 4.1 of 20 VII grade students of MTs Tropodo Krian, there were 14 students who had a field dependent cognitive style and 6 students who had a cognitive field independent style

Based on the results of GEFT, 2 students with GEFT scores approached 0, namely S12 with a score of 3 and S15 with a score of 4. Both of these subjects were the subjects who had the strongest tendency in the cognitive field dependent (FD) style because they had scores close to 0 from each student's score. class VII which follows GEFT. In addition, from the GEFT results obtained 2 students with a GEFT score of close to 18 namely S8 with a score of 13 and S19 with a score of 15. Both subjects were the strongest tendency in the cognitive field independent (FI) because they had a score close to 18 from each score -every class VII student who took the GEFT test. The list of research subjects is presented in table 4.2 below:

Table 2. List of Research Subjects

No	Subject Code	Cognitive Style
1	S12	*Field Dependent*
2	S15	*Field Dependent*
3	S8	*Field Independent*
4	S19	*Field Independent*

3.2. Test of Problem Solving Abilities and Interviews Result

Based on problem solving tests and interviews, analysis students are presented in the description

below.

3.2.1. Field Dependent (FD) Students

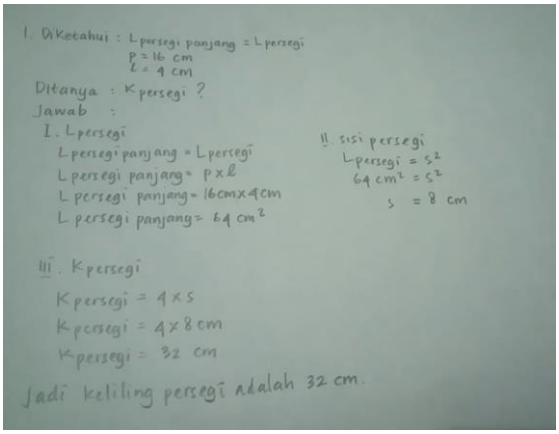

Figure 1. Test Abilities of S12 in Solving Problem 1

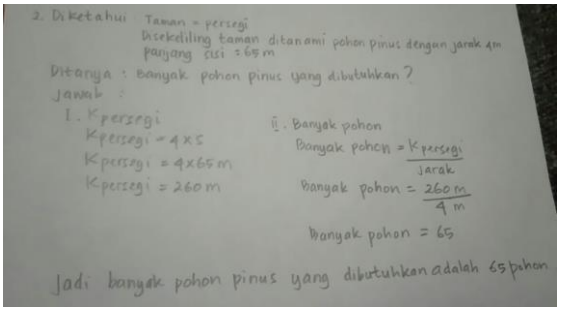

Figure 2. Test Abilities of S12 in Solving Problem 2

Based on the results of written tests, interview results, and triangulation results on problem 1, 2 it is concluded that the subject S12 solves that problem given by understanding the problem, planning a solution, implementing it settlement plan, and re-check. The S12 subject carries out two the problem solving stage according to Polya.

a. Understanding the Problem

The ability of the related S12 subject in understanding problems is included good category. The S12 subject is able to determine what is known and asked on the problem correctly, also able to explain the problem using the language and sentence itself even though the sentence used tends not much different from the question sentence.

b. Planning for Settlement

The ability of the S12 subject to planning a settlement is included in sufficient category. Subject S12 plans a settlement with determine the plan used to solve the problem and determine the formula used to solve the problem. When found a problem similar to another problem he had encountered S12 subjects tend to reuse the same plan and formula for resolve the problem.

c. Implement the Settlement Plan

The ability of subject S12 in carrying out the completion plan included in the less category. Subject S12 is able to apply each formula determined to solve the problem, but less able apply every step planned to resolve the problem. When facing a problem that is considered confusing, the subject of S12 is lacking able to carry out the right strategy when implementing that step planned to resolve the problem. S12 subjects tend to apply return plans, strategies and formulas

that have been used when find a problem that is similar to other problems ever he met.

d. Check again

The ability of the S12 subject to check back is included good category. The S12 subject checks the problem decisively conclusion of the problem, and re-examine the plan as well as the calculation have been done. Next, the subject S12 does not see any other alternatives for solve the problem.

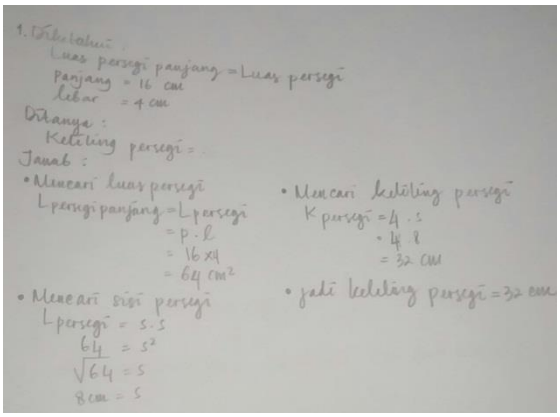

Figure 3. Test Abilities of S15 in Solving Problem 1

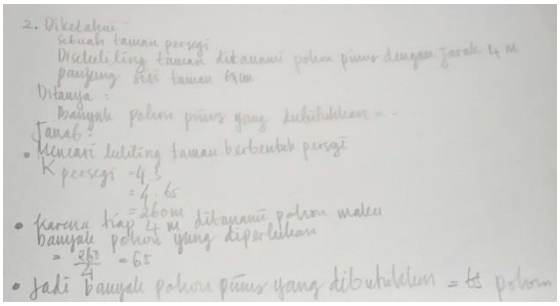

Figure 4. Test Abilities of S15 in Solving Problem 2

Based on the results of written tests, interview results, and triangulation results on Problems 1 and 2 concluded that the S15 subject solves a problem given by understanding the problem, planning a solution, implementing it settlement plan, and re-check. S15 subjects implement two the problem solving stage according to Polya.

a. Understanding the Problem

The ability of the S15 subject related stages of understanding problems is included good category. S15 subject is able to determine what is known and asked on the problem correctly and completely. S15 subjects were also able to explain problems using their own language and sentence, even if the language is use tends not to be very different from the question language.

b. Planning for Settlement

The ability of the S15 subject is related to the stage of planning completion included in the sufficient category, the S15 subject is able to plan a settlement correctly. Subject S15 plans a decisive solution plans that are used to solve problems and tend to be able determine the formula used to solve the problem. But for problems that are considered difficult, S15 subjects are less able to determine the formula used to solve problems. When finding a problem similar to the problems he had encountered the subject S15 tended to reuse the same plan and formula to complete the problem.

c. Implement the Settlement Plan

The ability of the S15 subject is related to the stage of implementing the completion plan included in the less category. S15 subjects are less able to apply each planned steps to resolve problems and underprivileged apply each formula specified to solve the problem. In in some cases, S15 subjects were less able to choose and implement strategies the right when implementing the steps planned to complete problem. Subject S15 is also less able to apply the formula that has been determined when resolving problems that are considered difficult. When finding a problem similar to the problem he had encountered, the subject of S15 tend to reapply the plans, strategies, and formulas that have already been done used.

d. Check again

The ability of S15 subjects related to the re-examination stage is included enough category. Subject S15 is able to determine the conclusion of the problem however tend not to re-examine plans and calculations that have been done if the time given to solve the problem is limited. The S15 subject did not see any other alternative to answer the problem.

3.2.2. Field Independent (FI) Students

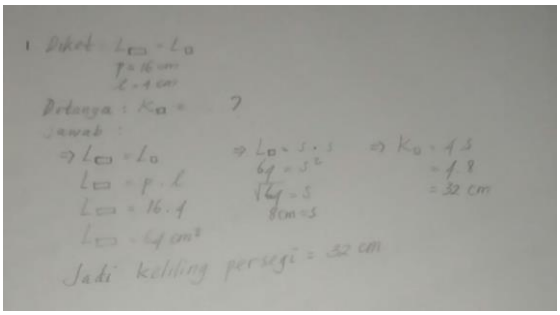

Figure 5. Test Abilities of S8 in Solving Problem 1

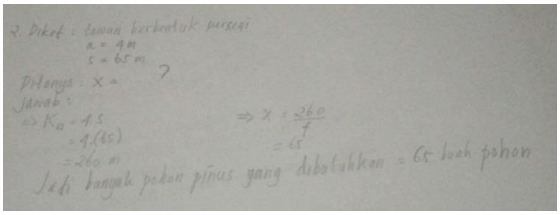

Figure 6. Test Abilities of S8 in Solving Problem 2

Based on the results of written tests, interview results, and triangulation results on problems 1 and 2 concluded that the S8 subject solves that problem given by understanding the problem, planning a solution, implementing it settlement plan, and re-check. The S8 subject carries out two the problem solving stage according to Polya.

a. Understanding the Problem

The ability of S8 subjects related to understanding the problem is included good category. The S8 subject is able to determine what is known and asked on the problem briefly and use mathematical notation. S8 subject also able to explain the problem using his own language and sentence.

b. Planning for Settlement

The ability of the S8 subject is related to the planning phase of completion included in the good category. The S8 subject was able to determine the plan used to solve problems and be able to determine the formula used to solve problems.

c. Implement the Settlement Plan

The ability of S8 subjects related to the stage of implementing the completion plan included in the category enough. The S8 subject is able to apply each formula who have been determined to solve the problem and tend to be able apply every step planned to resolve the problem. For problems that are considered confusing, despite being able to obtain correct results, S8 subjects are less able to choose and implement strategies the right when implementing the steps planned to complete problem.

d. Check again

The ability of S8 subjects related to the rechecking stage is included enough category. The S8 subject was able to determine the conclusions obtained but do not check the plan and calculation that has been done. This matter occurs because the subject of S8 feels the results obtained are correct. Other than that, S8 subjects tend to be able to see other alternatives in completing problem.

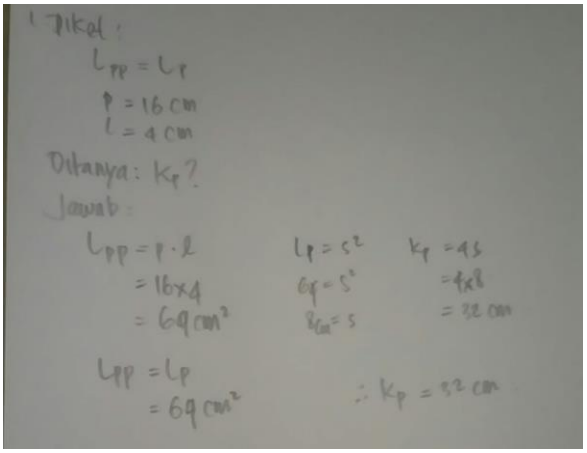

Figure 7. Test Abilities of S19 in Solving Problem 1

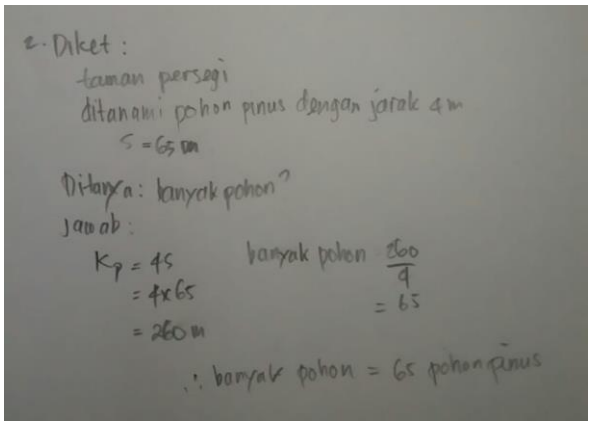

Figure 8. Test Abilities of S19 in Solving Problem 2

Based on the results of written tests, interview results, and triangulation results on problems 1 and 2 concluded that the subject S19 solved the problem given by understanding the problem, planning a solution, implementing it settlement plan, and re-check. The S19 subject carries out two the problem solving stage according to Polya.

a. Understanding the Problem

The ability of the S19 subject related stages of understanding problems is included good category. Subject S19 is able to determine what is known and asked on the problem briefly and use

mathematical notation. S19 subject also able to explain the problem using his own language and sentence.

b. Planning for Settlement

The ability of the subject S19 is related to the planning stage of completion included in the good category. The S19 subject was able to determine the plan used to solve problems and be able to determine the formula used to solve problems. Although faced with a problem who had already been encountered, the S19 subject tended not to reuse a plan that has been used before.

c. Implement the Settlement Plan

The subject ability of S19 is related to the stage of implementing the completion plan included in the good category. Subject S19 carries out a settlement plan by applying each predetermined formula to complete problem and be able to implement every step planned for solve the problem. S19 subjects tend not to re-apply plans, strategies and formulas that have been used before when faced with problems that have been encountered. S19 subject too tend to be able to get the right results when solving problems.

d. Check again

The ability of the S19 subject related to the rechecking stage is included enough category. Subject S19 was able to determine the conclusions obtained but do not check the plan and calculation that has been done. This matter occurs because the subject S19 feels the results obtained are correct. S19 subject see no other alternative in solving the problem.

4. Conclusion and Suggestion

4.1. Conclusion

Based on the results of the analysis and discussion that has been conducted regarding the epistemic cognition of students in solving mathematical problems in terms of the cognitive style of the field independent and field dependent, it can be concluded that:

a. Epistemic cognition of students with cognitive field independent style in solving mathematical problems including the dominant rational level. This can be seen from the epistemic characteristics of cognition of students in solving mathematical problems, namely students tend to use more metacognition strategies, especially monitoring and control of new information and the application of steps, approaches and justifications in solving problems rationally.
b. Epistemic cognition of students with cognitive field dependent styles in solving mathematical problems including the level of empirical rationality. This can be seen from the epistemic characteristics of the cognition of students in solving mathematical problems. Students use metacognition strategies, rational problem solving approaches and justification in solving problems rationally empirically.

4.2. Suggestion

Based on the conclusions of the results of the study, some suggestions that the researcher could point out are as follows:

a. For teachers it is expected to be able to provide learning in accordance with metacognition strategies, problem solving approaches, and justifications that students often do in solving mathematical problems.
b. For other researchers who want to do research on epistemic cognition of students in solving mathematical problems, can develop research using research techniques and other reviews.

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