ABILITY OF MATHEMATICS OLYMPIC PARTICIPANTS WITH FIELD INDEPENDENT COGNITIVE STYLE IN SOLVING GEOMETRIC MATERIAL PROBLEMS

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Abstract: In this modern era, mathematics is an important aspect that determines the progress of a nation. Pursuing mathematics can contribute to students' logical, analytical, systematic, critical and creative thinking. These competencies are needed so that students are able to obtain, digest and use various data to compete in dynamic and competitive conditions. Problem solving is one of the appropriate methods for studying and doing mathematics. Students who have skills in solving problems will have several advantages, including improving critical thinking skills, strengthening mathematical skills. Problem solving is a process or individual effort to respond to or overcome obstacles or obstacles when an answer or method of answering is not yet clear. MAN 2 Jombang often includes its students in mathematics olympiads. Therefore, the researcher took the research object at MAN 2 Jombang which according to the researcher was very appropriate for this research.

Keywords: Mathematics Olympiad, Cognitive Style, Field Independent, Problem Solving

Introduction

In this modern era, mathematics is an important aspect that determines the progress of a nation. Pursuing mathematics can contribute to students' logical, analytical, systematic, critical and creative thinking. KThese competencies are needed so that students are able to obtain, digest and use various data to compete in dynamic and competitive conditions. This is the reason why mathematics is facilitated as a subject in schools from lower school to high school, especially up to high school. Therefore, mathematics education should receive significant attention for educators to achieve learning success for students so that they are able to compete in experiencing life's problems. According to Government Regulation Number 19 of 2015 concerning National Education Standards article 1 paragraph 19, namely that learning is a process of interaction between students, between participants. students with educators and learning resources in a learning environment.[1]If we look further, K13 (2013 Curriculum) prioritizes problem solving abilities which are carried out using appropriate steps in solving them which have been explained in detail and systematically, so that students are expected to have good problem solving abilities. This is reinforced by data based on the National Council of Teaching Mathematics (NCTM)

[1]Government Regulation no. 19 of 2015 concerning National Education Standards, Article 9. (Online) available at:http://ft.unm.ac.id/wp-content/uploads/2018/01/PP-No-13- Tahun-2015.pdf, (4 October 2023 p. 5.

school mathematics standards including material content standards and process standards for obtaining them, process standards include (1) problem solving; (2) reasoning and proof; (3) linkage; (4) communication and (5) representation.[2]Among them, problem solving is the heart of mathematics, so it is very clear that problem solving is very important in mathematics. However, in reality, the mathematical problem solving abilities of students in Indonesia are still very low, this can be seen from a series of TIMMS and PISA results which have been the benchmark for students' problem solving abilities in the world, where students from Indonesia still have results that are below average.[3]

If we look at the report released by PISA in 2018 regarding problem solving abilities, Indonesian students' mathematics scores rank 72nd out of 78 countries surveyed. The average score of Indonesian students is 379 below the average score of students in other countries, namely 489.[4]On the one hand, madrasa students have lower problem solving abilities than public school students, this can be seen from mathematics competitions or Olympiads which use a lot of problem solving questions. Madrasa students can be said to be far behind public school students. This can be seen, for example, from the 2018 OSN results, only 7 madrasa students out of 132 students qualified for the national level in Mathematics.[5]

Regarding the problem above, MAN 2 Jombang's response to problems like this shows that there are differences with the style of thinking of problem solving abilities in the Olympics. Furthermore, problem solving skills are one of the main aspects of mathematics that students need to practice and integrate many mathematical concepts and skills for making decisions. Students with a field independent cognitive style have more complex mathematical problem solving responses compared to students with a field dependent cognitive style whose method of processing is more general.[6]The ability to think creatively in solving problems by Olympiad students is also influenced by learning style. This is in accordance with Firdausi's statement that many students are not aware of a learning style that suits their personality and an unsuitable learning style can result in students having difficulty solving complex

[2]Fadjar Sadiq, Learning to Solve Mathematical Problems, (Yogyakarta: Graha Ilmu. 2014), p. 2

[3]Muslihah Rohmah and Sugeng Sutiarso. Analysis of problem solving using Newman theory, (Eurasian Journal of Mathematics, Science and Technology education), p. 1accessed fromhttp://www.ejmste.com/Analysis-Problem-Solvi

[4].PISA 2018 , Insights and Interpretations, Available: https://www.oecd.ord/pisa/PISA%202018%20Insights%20and%20Interpretations%20FINAL%20 PDF.pdf, (1 May 2023), p. 35.

[5]Taken fromHttp://Dikdasmen.Kemdikbud.Go.Id/Wp-Content/Uploads/2018/05/DaftarParticipants-MTK.PdfAccessed October 5, 2023

[6]Ngilawajan, "Thinking Process of High School Students in Solving Mathematical Problems with Derived Material Seen from Field Independent and Field Dependent Cognitive Styles," Journal of Educational Sciences, Vol. 2, no. 1, (2013), p. 9.

problems.[7]Based on the type of research in the form of a case study contained in the manuscript of this article, therefore, according to the researcher, the appropriate method is to use qualitative research methods.

Method

This research is research that uses qualitative methods with a case study type of research. Qualitative research according to Lexy J. Maleong is research that intends to understand phenomena about what is experienced by research subjects, for example behavior, perception, motivation, actions as a whole (holistic) and by means of descriptions in the form of words and language in a specific context. naturally and by using various natural methods.[8]Bogdan and Taylor say that qualitative research is a research process that produces descriptive data in the form of written and spoken words from several people and observable behavior. This research prioritizes descriptive data in the form of writing, verbal statements and observed behavior, rather than data with numbers.[9]Besides that,The research subjects were 2 subjects who came from students participating in the MAN 2 Jombang mathematics olympiad. A total of 5 olympiad participants based on field independent cognitive style.

This research is research that aims to describe the mathematical problem solving abilities of participants in the MAN 2 Jombang Mathematics Olympiad on geometry material in terms of field independent cognitive style. This research was carried out at MAN 2 Jombang with the research subjects coming from mathematics olympiad students taken by two students with a field independent cognitive style.

Results and Discussion

Based on the results of data collection, this chapter will describe a discussion regarding the results of research findings regarding mathematical problem solving abilities in geometry materials based on cognitive style.*field independent* students participated in the MAN 2 Jombang Olympiad. Problem solving abilities are intended to examine and improve students' thinking processes based on problem solving activities according to the theory put forward by Polya. According to Polya, the stages of problem solving are understanding the problem, preparing a

[7]YN Firdausi, et al. "Analysis of Students' Creative Thinking Abilities in View of Learning Styles in Eliciting Activities (MEA) Learning Model". PRISM. Vol 1, No. 2. February 2018, p. 240.

[8]Lexy J. Maleong, Qualitative Research Methodology, (Bandung: PT. Teen Rosdakarya, 2014), p. 6

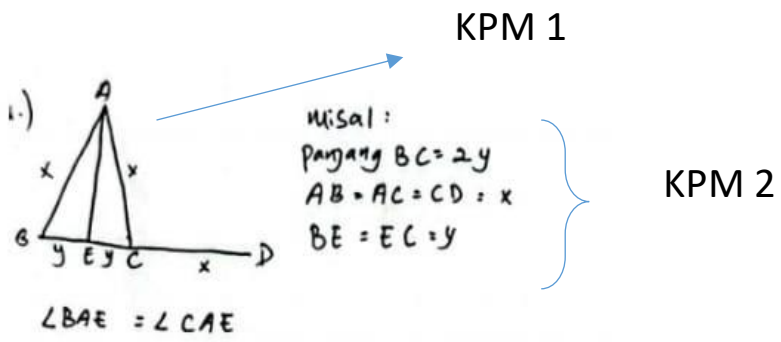
[9]Bogdan.RC and Taylor.SJ, Intruduction to Qualitative Research Methods, (Boston: John Wilev & Sons, 1975), p. 45

resolution plan, implementing the resolution plan, re-examining the procedures and results of the solution.[10]

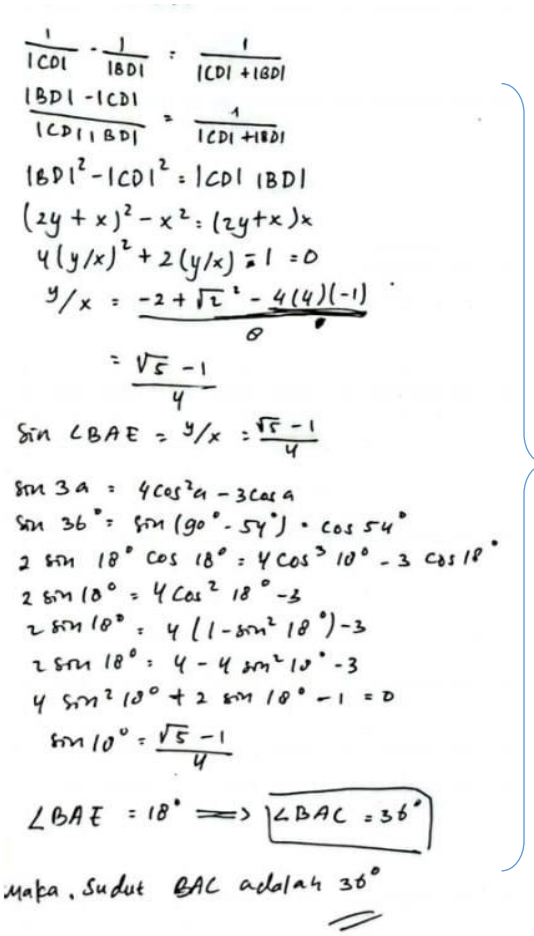
In presenting this data, data on geometric problem test results and interview data relating to geometric problem test results on research subjects and their analysis will be presented. The analysis of test and interview results aims to further examine the mathematical problem solving abilities of participants in the MAN 2 Jombang mathematics olympiad on geometry material that has been carried out, as well as to see students' mistakes in solving geometry problems both conceptually and procedurally . From this data, it will be used as a benchmark in carrying out the process of mathematical problem solving abilities. Based on Polya's steps in problem solving, the indicators that researchers want to know when students work on mathematical problems. The explanation is as follows:

a. Subject 1

1) Display of Test and Interview Results Data in Solving TKPMM question number 1



[10] Ira Purnamasari and Wahyu Setiawan, "Middle School Students' Mathematical Problem Solving Ability on SPLDV Material Seen from Initial Mathematics Ability (KAM)", in Journal of Medicine 3, no. 2 (2019): 209



KPM 3

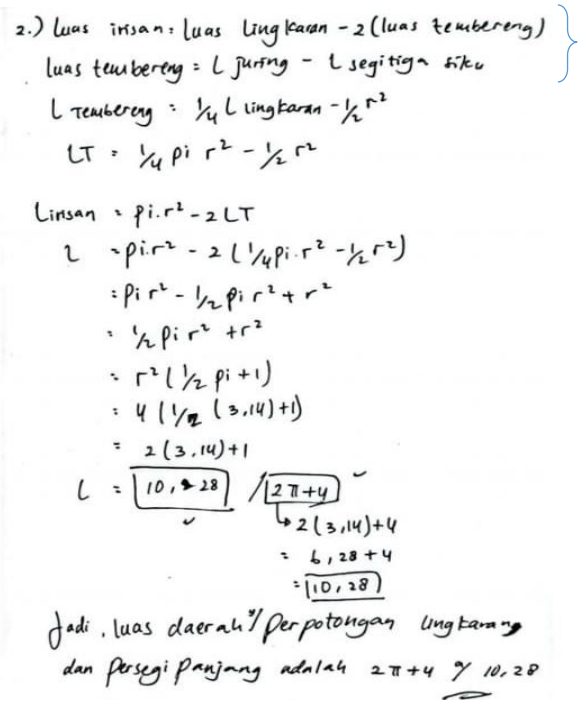
Based on the picture above, it is shown that subject 1 solved question number 1 smoothly and with correct marks. Subject 1 understands the questions written clearly in KPM 1 and can estimate the correct solution process seen in KPM 3. The initial step taken is to write down and illustrate what is known in the questions written in KPM 1. Then subject 1 calculates the equation of 2 angles to find one of the angles asked about which is explained in KPM 2. After getting the answer, subject 1 makes a conclusion from the answer that has been worked out. Next, the researcher conducted an interview with subject 1 regarding the answer to question number 1 which was clearly visible in KPM 3.

P	*: What do you think the form of the problem being worked on will look like?*
Subject1	*: The question is quite difficult, but I understand, sis*
P	***: Do you understand the meaning of the question?***
Subject1	***: I can understand, sis***
P	***: Try explaining the meaning of the question in your own words?***
Subject1	***: What I understand is points B, C, D become one triangle and point Awhich is not located on line BD, so point A will be near BC, sis, and fulfills what is known from the problem. Then what is asked is the angle of BAC***
P	*: Do you have difficulty working on the questions?*
Subject1	*: A little sis*
P	*: Is the material you have received sufficient to solve the problem?*

Subject1	*: This material was a long time ago so I forgot a bit, but luckily I remembered to calculate the angle, sis*
P	*: Is there any other event to solve this problem?*
Subject1	*: Maybe there is but I don't know either hehehe*
P	*: Do you have difficulty with calculations?*
Subject1	*: No*
P	*: After finishing working on the question, are you sure about it? Have you worked on the answer?*
Subject1	*: Sure but not 100% sis*
P	***: Every time you ask a question, do you always check the answer?you do?***
Subject1	***: Yes, sis, to confirm my calculations, sis***
P	*: So what is the final conclusion from this question?*
Subject1	*: According to what I calculated, the result is that the BAC angle is 36°*

Based on the results of tests and interviews conducted by researchers with subject 1 on question number 1, it can be concluded that subject 1 has good abilities in understanding problems. This is shown when the subject writes down what is known and what is asked in the problem, and is able to explain the process of solving the problem. Furthermore, the subject is also very good at planning the solution. The subject is able to carry out the settlement plan. Then at the stage of checking the process and results again, you also have good abilities. This is shown when the subject is able to write down the conclusions obtained in solving the problem.

2) Display of Test and Interview Results Data in Solving TKPMM question number 2



Based on the picture above, it is shown that subject 1 solved question number 2 smoothly and with correct marks. Subject 1 understands the questions and can estimate the correct solution process seen in KPM 2. The initial step taken is to write down the question formula from the

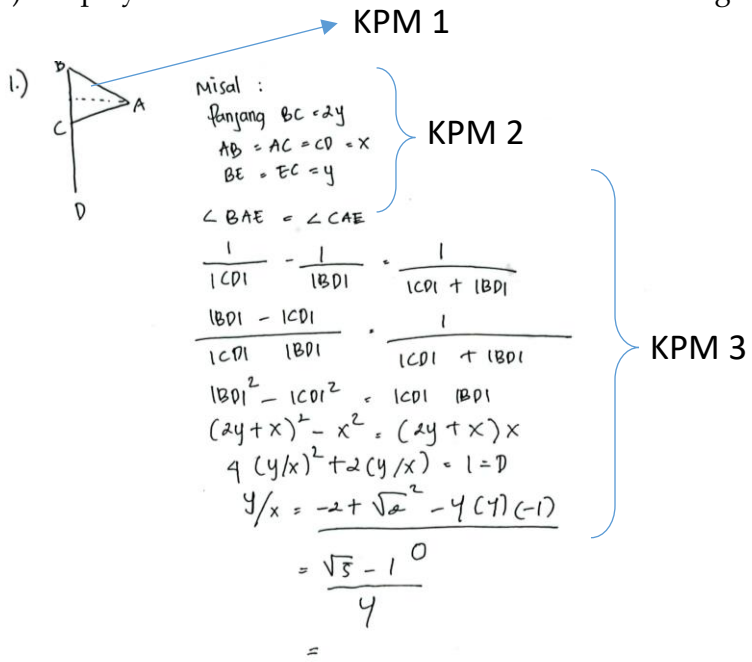
written questions in KPM 2 then in KPM 3 subject 1 calculates from the formulas he understands. After getting the results, then subject 1 makes a conclusion from the answers that have been worked out. Next, the researcher conducted an interview with subject 1 regarding the answer to question number 2.

P	*: What do you think the form of the problem being worked on will look like?*
Subject 1	*: Pretty easy, sis, hehehe*
P	***: Do you understand the meaning of the question?***
Subject 1	***: I can understand, sis***
P	***: Try explaining the meaning of the question in your own words?***
Subject 1	***: From the picture in the question, I can find the area of the intersection, so to find the intersection, I can use the area of the circle - 2 times the area of the intersection. From there you can find the result, bro.***
P	*: Do you have difficulty working on the questions?*
Subject 1	*: No sis*
P	*: Is the material you have received sufficient to solve the problem?*
Subject 1	*: Enough*
P	*: Is there any other event to solve this problem?*
Subject 1	*: Maybe not, sis*
P	*: Do you have difficulty with calculations?*
Subject 1	*: No*
P	*: After finishing working on the question, are you sure about it? Have you worked on the answer?*
Subject 1	*: God willing, I'm sure*
P	***: Every time you ask a question, do you always check the answer?you do?***
Subject 1	***: Yes, of course, sis, to confirm my calculations, sis***
P	*: So what is the final conclusion from this question?*
Subject 1	*: Final answer 10.28 sis*

Based on the results of tests and interviews conducted by researchers with subject 1 on question number 2, it can be concluded that subject 1 has good abilities in estimating the solution process. This is shown when the subject explains the problem solving process correctly. Furthermore, the subject is also quite good at planning solutions. The subject carries out the completion plan, then at the stage of reviewing the process and results also has good abilities. This is shown when the subject writes down the conclusions obtained in solving the problem.

b. Subject 2

1) Display of Test and Interview Results Data in Solving TKPMM question number 1



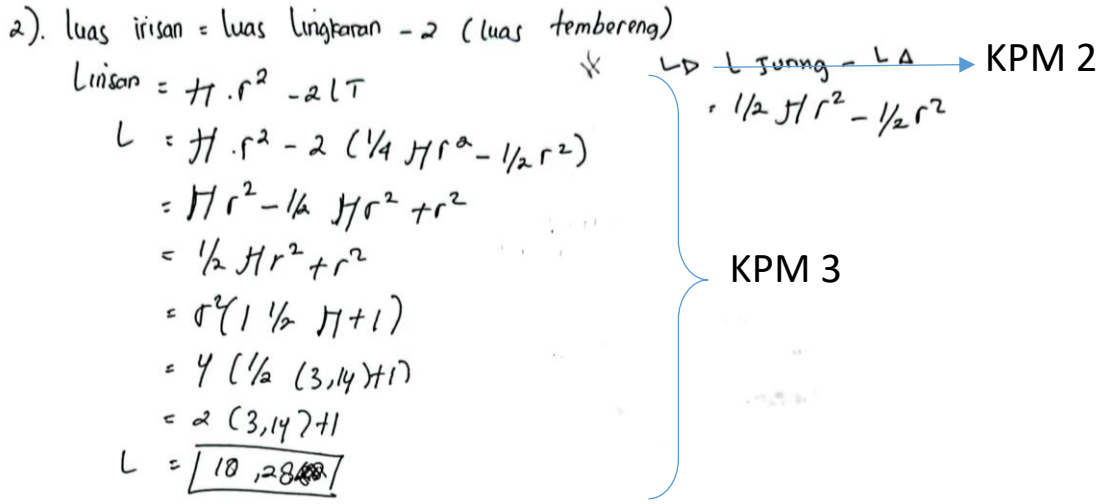
Based on the picture above, it is shown that subject 2 did not solve the problem in number 1. In KPM 1 Subject 2 understands the problem and can estimate the solution process correctly as seen in KPM 2 and KPM 3. The first step taken is to write down and describe what was done. known in the question. Then in KPM 2, the SDW subject planned a solution using his understanding, then subject 2 calculated the equation of 2 angles to find one of the angles asked about and did not complete the calculation as seen in KPM 3. Next, the researcher conducted an interview with subject 2 regarding the answer to question number 1.

P	*: What do you think the form of the problem being worked on will look like?*
Subject 2	*: It's difficult, sis*
P	***: Do you understand the meaning of the question?***
Subject 2	***: That's not bad, sis***
P	***: Try explaining the meaning of the question in your own words?***
Subject 2	***: What I understand is points B, C, D become one and point Awhich is not located on the BD line, actually I understood how to do it, but I stopped because I was confused after that, how to do it, bro.***
P	*: Do you have difficulty working on the questions?*
Subject 2	*: Yes bro*
P	*: Is the material you have received sufficient to solve the problem?*
Subject 2	*: Hehehehe, God willing, that's enough, sis*
P	*: Is there any other event to solve this problem?*
Subject 2	*: I don't know, maybe there are many*
P	*: Do you have difficulty with calculations?*
Subject 2	*: Yes bro*
P	*: After finishing working on the question, are you sure about it? Have you worked on the answer?*
Subject 2	*: Not sure sis*
P	***: Every time you ask a question, do you always check the answer?you do?***

Subject 2 ***: Yes, I checked again, bro, but still couldn't find the answer***
P *: So what is the final conclusion from this question?*
Subject 2 *: I haven't finished working on it yet, bro, so I don't know*

Based on the results of tests and interviews conducted by researchers with SDW subjects in question number 1, it can be concluded that SDW subjects have good abilities in understanding problems. This is shown when the subject writes down what is known and what is asked in the problem, but is unable to complete the process of solving the problem. Then at the stage of checking the process and results again, you also have good abilities. This is shown when the subject re-examines the results of his work but cannot complete it well.

2) Display of Test and Interview Results Data in Solving TKPMM question number 2



Based on the picture above, it is shown that subject 2 solved question number 2 smoothly and with correct marks. In KPM 2 subject 2 understands the problem and can estimate the correct solution process and continues in KPM 3 subject 2 carries out planning correctly and precisely. The initial step taken is to write down what he understands from the questions and the question formulas from the questions shown in KPM 2 then subject 2 calculates from the formulas he understands. After getting the results, then subject 2 made conclusions from the answers that had been done as seen in KPM 3. Next, the researcher conducted an interview with subject 2 regarding the answer to question number 2.

P *: What do you think the form of the problem being worked on will look like?*
Subject 2 *: Quite easy, sis*
P ***: Do you understand the meaning of the question?***
Subject 2 ***: Can***
P ***: Try explaining the meaning of the question in your own words?***
Subject 2 ***: What is asked is the shaded area so just calculate***
P *: Do you have difficulty working on the questions?*
Subject 2 *: No*
P *: Is the material you have received sufficient to solve the problem?*

Subject 2 : Enough
P : Is there any other event to solve this problem?
Subject 2 : There doesn't seem to be anything, sis
P : Do you have difficulty with calculations?
Subject 2 : No
P : After finishing working on the question, are you sure about it? Have you worked on the answer?
Subject 2 : Sure, I hope it's true, hehehe
P : Every time you ask a question, do you always check the answer?you do?
Subject 2 ***: Yes, of course, sis***
P : So what is the final conclusion from this question?
Subject 2 : My calculation result is 10.28 sis

Based on the results of tests and interviews conducted by researchers with subject 2 on question number 2, it can be concluded that subject 2 has good abilities in estimating the completion process. This is shown when the subject explains the process of solving the problem correctly. Furthermore, the subject is also quite good at planning solutions. The subject carries out the completion plan, then at the stage of reviewing the process and results also has good abilities. This is shown when the subject writes down the conclusions obtained in solving the problem.

In this research, subjects who have the Field Independent cognitive style based on the analysis carried out on written test results and interview results are generally able to complete the four indicators of mathematical problem solving abilities in this research. The explanation is as follows:

a) Problem Understanding

Subjects with a Field Independent cognitive style can understand problems well and correctly. Subjects can both understand the problem, this can be seen when the subject can determine the plan used to solve the problem and can explain the problem in his own language and sentences. This is in line with what was stated by Siti Hajar et al that students with mathematical problem solving abilities using the FI cognitive style "FI subjects are able to observe problems and identify the information in the problem, namely stating what is known and what is asked about the problem."[11]The subject meets the predicate of good in the indicator of understanding the problem, it can be seen that the subject can determine the plan used to solve the problem and can explain the problem with his own language and sentences.

b) Completion Planning

Subjects with the Field Independent cognitive style also meet indicator 2. Subjects both know the planning process for solving the problems given. It can be seen that the subject can determine the plan

[11] Siti Hajar, et al, "Solution Characteristics..., p. 95.

used to solve the problem and can determine the formula used to solve the problem. This is because Field Independent subjects can process information and recall the material that has been presented. This is in line with the statement of Eka Resti Wulan et al that students with FI cognitive style problem solving abilities "FI subjects prepare plans and take actions that lead to the correct solution, because the subjects are able to organize information independently."[12]The subject meets the predicate of good on the indicator of planning a solution, it can be seen that the subject can determine the plan used to solve the problem and is able to determine the formula used to solve the problem.

c) Implementing Planning

In indicator 3, it can be seen that subjects with the FI cognitive style can apply every planned step to solve the problem. This can be seen from the two subjects being able to apply every predetermined formula to solve the problem. Except for question number 1, subject S4 can only plan but cannot complete the planning. This is in line with Alifah and Aripin's statement, that "FI subjects are able to separate essential information from its context and are more selective in absorbing information that has been received, able to analyze patterns into their components."[13]The subject fulfills the predicate as sufficient in terms of the ability to carry out the solution plan. It can be seen that the subject can apply every planned step to solve the problem or can apply every predetermined formula to solve the problem.

d) Re-Inspection

This indicator shows that the subject can determine the conclusion of the problem and re-examine the plans and calculations that have been determined. It can be seen from what the subject does that he can solve the questions given and almost always rechecks the answers he has done.

Conclusion

Based on the results of research and discussion of Olympiad Participants with Field Independent Cognitive Style on geometry material at MAN 2 Jombang, it can be described as follows: Students with FI cognitive style understand the problem given directly, can determine what is known and what is asked and can explain the problem using language. and own sentences. As for the process of planning a solution, it can be seen that students can determine a plan by determining the formula used to solve the problem. In the process of carrying out a solution plan, it can be seen that students can implement every planned step and apply every formula that has been determined to solve the problem. In the process of

[12] Eka Resti Wulan, et al, "Field-Dependent Cognitive Style..., p. 134.

[13] Nur Alifah, "Thinking Process of Middle School Students in Solving Mathematical Problems in View of Field Dependent and Field Independent Cognitive Styles", Journal of Innovative Mathematics Learning, Vol. 1, No. 4, (2018), p. 510.

reviewing the process and results, it can be seen that students can draw conclusions from the problems given. Overall, it appears that students with the FI cognitive style are quicker to recall the material presented by the teacher.

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