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Mathematic Reasoning Ability Based on Cognitive Style Field Dependent, Field Intermediate, and Field Independent

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Abstract: This study aims to see the effect of 3 types of cognitive styles on students' mathematical reasoning abilities. According to previous research, there has been no research that discusses the 3 types of cognitive styles on mathematical reasoning abilities. The method in this study is a qualitative descriptive approach. The total population of this study was 32 people who sat in SMA class X MIPA A. The selection of subjects in this study was viewed from the top results based on 3 categories of field dependent cognitive style, intermediate field and field independent. So that the main sample is 3 people by representing each category of cognitive style. The selected subjects will be given a follow-up test, namely an interview test related to mathematical reasoning abilities. The results of this study indicate that the intermediate field cognitive style category has higher mathematical reasoning abilities. The conclusion is that the type of student's cognitive style affects the results of mathematical reasoning abilities. Therefore, the teacher's task is to pay more attention to students' mathematical reasoning abilities according to their respective characteristics.

Keywords: mathematical reasoning ability, cognitive style, field dependent, field intermediate and field independent

Abstrak: *Penelitian ini bertujuan untuk melihat pengaruh dari 3 tipe gaya kognitif terhadap kemampuan penalaran matematis siswa. Menurut penelitian sebelumya belum ada penelitian yang membahas pada 3 tipe gaya kognitif terhadap kemampuan penalaran matematis. Metode pada penelitian ini adalah pendektakan deskriptif kualitatif. Jumlah populasi penelitian ini 32 orang yang duduk dibangku SMA kelas X Mipa A. Pemilihan subjek dalam penelitian ini ditinjau dari hasil teratas berdasarkan 3 kategori gaya kognitif field dependent, field intermediate dan field independent. Sehingga yang menjadi sampel utama sebanyak 3 oraang dengan mewakili setiap kategori gaya kogntif. Subjek yang terpilih akan diberikan tes lanjutan yaitu tes wawancara terkait soal kemampuan penalaran matematis. Hasil penelitian ini menunjukan bahwa kategori gaya kognitif field intermediate memiliki kemampuan penalaran matematis lebih tinggi. Kesimpulannya bahwa tipe gaya kognitif siswa mempengaruhi hasil kemampuan penalaran maematis. Oleh sebab itu, tugas guru lebih memperhatikan kemampuan penalaran matematis siswa sesuai dengan karakteristiknya masing-masing.*

Kata kunci: *kemampuan penalaran matematis, gaya kognitif, field dependent, field intermediate dan field independent.*

▪ INTRODUCTION

Metamatic reasoning ability is the process of drawing conclusions based on existing and verifiable information (Faradillah, 2018) . The truth is needed by students, one of which is in the classroom. In the classroom there will be teaching and learning activities and students in this case are required to be able to respond to every learning they get and also in answering questions. Learning and developing activities are inseparable from mathematical reasoning abilities (Shodikin, 2017) . In this case, a student who has good mathematical reasoning abilities can do better in learning than

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those who lack mathematical reasoning abilities (Hadi & Faradillah, 2019) . Mathematical reasoning is important to maximize student involvement in communication, questioning, explanation and elaboration so that students can better express their ideas (Kramarski & Mevarech, 2003) . Mathematical reasoning ability is needed by students, one of which is in class when answering questions. Because mathematical reasoning ability is important when students answer math problems, in this case mathematics learning must pay attention to mathematical reasoning because this is where the student's skills will be seen (Ayal, 2016)

The skills possessed by students make students more confident in doing math problems. The existence of confidence in students has an impact on the level of student achievement. according to one study that student achievement in mathematics can be predicted or determined by the student's mathematical reasoning ability (Adegoke, 2013) With mathematical reasoning supports students in critical thinking, creativity and in solving problems (Watrianthos, 2019). The importance of other mathematical reasoning abilities is found in the finding that with the reasoning ability students will be involved in communication, questions, explanations and elaborations so that students can express their ideas better (Kramarski & Mevarech, 2003) . previous findings. But in this case every student has a way and the factors that influence it. One of the factors that influence it is a factor that comes from within students or is called cognitive style. In this case, cognitive influences students in knowledge, understanding, application, analysis, evaluation and creation (Novilia et al., 2016) .

Cognitive style is a link between personality and intelligence (Ulya, 2015) . Cognitive style is a characteristic that is unique to each individual in their environment(Hayati, Fatkhurrohman, & Learning, 2020).Cognitive style influences a person in terms of obtaining, organizing and interpreting the information obtained to guide their every action (Guisande et al., 2007) . Cognitive style influences a person in terms of obtaining, organizing and interpreting the information obtained to guide their every action (Vega-Vaca & Hederich-Martínez, 2015) . Cognitive style is an important factor for each individual in the learning process and cycle, in addition, other studies have shown that cognitive style affects the focus and type of activity of each individual (Riding & Sadler-Smith, 1997; Sadler-Smith & Riding, 1999) . There is a study related to cognitive style which is very influential on student achievement in this study, it can be seen that there is a relationship between academic achievement and students (Fatemi et al., 2014) . Cognitive style is one of the important factors for each individual in carrying out the learning process and cycle (Riding & Sadler-Smith, 1997) . In addition, other research suggests that cognitive style affects the focus and type of activity of each individual cited by (Sadler-Smith & Riding, 1999) . Judging from several existing studies, it can be said that the cognitive style of students or each individual is needed both in terms of achievement, student focus, and various activities. or each individual is needed both in terms of achievement, student focus, and the various activities they have.

Cognitive styles are generally divided into 2, namely Field Dependent (FD) and Field Independent (FI) (Witkin et al., 1977) . But several other researchers found new findings from the development of cognitive styles, namely into 3 types. According to cognitive style, harmony is divided into 3, namely Field Dependent (FD), Field Intermediate (FDI), and Field Independent (FI) (Ulya, 2015) . Cognitive styles in other studies are divided into 3, namely Field Dependent (FD), Field Intermediate (FDI), and

Field Independent (FI). Dependent (FD), Field Intermediate (FDI), and Field Independent (FI). In another study it was found that the character of FD (Field Dependent) to motivate students externally is to seek guidance and guidance from others. As for the FI (Field Independent) character, students are able to independently analyze problems, analyze, detect patterns, evaluate, and critically detail a problem and the last is the FDI (Field Intermediate) character. This character is a combination of FD and FI (Wakit) characters. & Hidayati, 2020).

Based on the research findings, it can be seen that the importance of mathematical reasoning ability and cognitive style in students. With the various types of cognitive styles that existed in previous studies, this study will take 3 types of cognitive styles. As has been explained, these 3 types of cognitive style are a new type where not many researchers have conducted research related to it. So based on this, the purpose of this study is to see the effect of 3 types of cognitive styles on students' mathematical reasoning abilities.

▪ METHOD

The method used in this research is a descriptive qualitative approach. Descriptive qualitative method is a direct description method based on existing phenomena such as who, what, and where the event or experience produces data in the form of words, both derived from theory and research findings that have been observed (Sandelowski, 2000; Turale, 2020) . This research was conducted at a public high school in Jakarta with a population of 32 students. The instruments used in this study were questionnaires related to cognitive style, questions about mathematical reasoning abilities, and interviews. The first step in this research is to validate the instruments related to mathematical reasoning abilities by expert validators such as mathematics teachers and lecturers. If the questions are declared valid by the experts, then the next step is the process of validating the instrument about mathematical reasoning abilities to students. The students selected in this study were high school students in class XI MIPA A and XI MIPA B with a total of 80 students.Validation to students is done by giving the questions then filled in by students to see the results of answers related to mathematical reasoning abilities. The results obtained were then calculated using the Winsteps application with the Rasch model for reliability and validity testing.

The Winsteps application was chosen because this application is not only Windows-based, which is very easily accessible by various types of laptops, there is also a Rasch model application. Rasch models specifically for educational tests, survey attitudes, objective measures, fundamentals, additives (meets the quality of compatibility of something), as well as evaluation of analytical scales (Linacre, 2012) . The reliability test was adapted from (Sumintono & Widhiarso, 2013), where the Cronbach Alfa statistic value (KR-20) with a fit index <0.5 low, 0.5-0.6 moderate, 0.6-0.7 good, 0.7-0.8 high, and >0.8 very high. For item and person values where the fit index is <0.67 low, 0.67-0.80 is sufficient, 0.81-0.90 is good, 0.91-0.94 is very good, and >0.94 is very good. And for person separation, if the high separation value indicates that the instrument has good quality because it can identify groups of items and people.

In this study, the results for Alfa Cronbach (KR-20) are 0.90, for Items of 0.84 and Person Reliability of 0.79, and the value of separation of persons is 2.15 and items of 1.94. Cronbach's alpha data value of 0.90 is "very high" based on the Winsteps results, which indicates that there is a lot of interaction between people and items. In

this case the instrument used is reliable. The person's reliability value is 0.84 with the "good" category meaning that the consistency of the respondent's answers is good, then the item reliability is 0.79 including the "enough" category which means the quality of the items in the instrument is " sufficient " . (Aziz & Psychology, 2015; Putri & Khusna, 2020; Sumintono & Widhiarso, 2013) So, it can be concluded that the instrument of mathematical reasoning ability is reliable. The next step is to test the test variables on the questions.

There are 3 criteria used in assessing item fit, namely Outfit Mean Square Values (MNSQ), Outfit Z-Standarized Values (ZSTD), and Point Mesure Correlation (PTMEA-CORR). Item Fit Order can see the level of item suitability (validity) which is used to explain whether the item functions normally in the measurement or not. If an item is found whose MNSQ and PT MEASURE CORR scores do not meet the criteria but the ZSTD score meets the criteria, the item is still considered fit or valid, meaning that the item is retained (Linacre, 2012). So based on the results of the validity with the Winsteps application that item number 2 is not appropriate or invalid because the item does not meet the three criteria for MNSQ and ZSTD scores. Therefore item number 2 must be replaced or discarded. After the instrument of mathematical reasoning ability is said to be valid and reliable, the next step is to test the mathematical reasoning ability of 32 high school students of class X MIPA A. With the same subject, the next test is field independent, field intermediate, and field dependent cognitive style tests. In this cognitive style test, the researchers adapted the question instrument with 3 types, namely field dependent, intermediate field, and field dependent, with cognitive style indicators (Prior, 2020) :

Table 1. GEFT test assessment

Indicators		**Subjects Were Selected Based on The Category of Cognitive Style**			
Correct Score	**Cognitive Style**	**Gender**	**GEFT Score**	**Cognitive Style**	**Code**
0-9	Dependent Field	Woman	9	Dependent Field	FD
10-13	Intermediate Field	Woman	12	Intermediate Field	FDI
14-18	Independent Field	Man	15	Field Independent	FI

In this study, 3 representative samples were selected from 32 students who would examine their cognitive style and mathematical reasoning abilities. The selection of 3 students was done randomly, but represented each cognitive style ability field dependent, field intermediate, and field independent. The selected subjects then took an interview test related to mathematical reasoning abilities. For the mathematical reasoning ability test, there are 4 indicators, namely presenting mathematical statements orally, in writing, tables, pictures, and diagrams, finding patterns or properties of mathematical phenomena to make generalizations, compiling and providing reasons for the correctness of solutions, and drawing conclusions from statements. logical statement (Jami & Wijayanti, 2020) .

▪ RESULT AND DISSCUSSION

Subjects were selected based on the category of students' cognitive style and then a mathematical reasoning ability test was taken. Indicators of mathematical reasoning ability based on presenting mathematical statements verbally, in writing, tables, pictures, and diagrams, finding patterns or properties of mathematical phenomena to make generalizations, compiling and providing reasons for the correctness of solutions, and drawing conclusions from logical statements (Jami & Wijayanti, 2020) . The process of analyzing students' mathematical reasoning ability tests based on the cognitive style categories FD, FDI, and FI and based on the guidelines for scoring mathematical reasoning abilities, namely a score of 4 if you can answer all aspects of reasoning correctly and answered correctly and clearly or completely, a score of 3 can answer almost all aspects questions about reasoning and answered correctly, a score of 2 can answer only part of the aspect of the question about reasoning and is answered correctly, a score of 1 answers incorrectly on the aspect of the question about reasoning or draws the wrong conclusion, and a score of 0 has no answer (Siti Rodiah 1, 2019) .

Table 2. Results of students' mathematical reasoning ability score

Code	**Mathematical Reasoning Ability Indicator**				**Score**
	Presenting mathematical statements orally, in writing, tables, pictures, and diagrams	**Finding patterns or properties of mathematical phenomena to make generalizations**	**Compile and provide reasons for the correctness of the solution**	**Draw conclusions from logical statements**	
FD	Subjects can answer almost all aspects of reasoning and are answered correctly. But not completely. Because the subject did not write down the information in the question	Subjects can answer only some aspects of reasoning and are answered correctly. The subject does not give a conclusion that shows the pattern in the answer question	Subjects can answer only some aspects of reasoning and are answered correctly. The subject did not give a right or wrong reason for the answer so that the answer became less valid and did not rewrite the information contained in the question	Subjects can answer only some aspects of reasoning and are answered correctly. The subject does not write down how to do it with a formula, only writes the answer so that the answer cannot be proven true.	Question score no. 1 = 3. Question score no. 3 = 2. Question score no. 4 = 2. Question score no. 5 = 2. Total score = 9
FDI	Subjects can answer almost all aspects of reasoning and are answered	Subjects can answer correctly all aspects of reasoning and are answered	Subjects can answer correctly all aspects of reasoning and	Subjects can answer correctly all aspects of reasoning and are answered	Question score no. 1 = 3. Question score no.

	correctly. But not completely. Because the subject did not write down the conclusion of the answer	correctly, clearly and completely	are answered correctly, clearly and completely	correctly, clearly and completely	3 = 4. Question score no. 4 = 4 Question score no. 5 = 4 Total score = 15
F I	Subjects can answer almost all aspects of reasoning and are answered correctly. But not completely. Because the subject did not write down the conclusion of the answer	Subjects can answer almost all aspects of reasoning and are answered correctly. But not completely. Because the subject did not write back the information on the question	Subjects can answer almost all aspects of reasoning and are answered correctly. But not completely. Because the subject did not write back the information on the question	Subjects can answer only some aspects of reasoning and are answered correctly. The subject does not write down how to do it with a formula, only writes the answer so that the answer cannot be proven true.	Question score no. 1 = 3. Question score no. 3 = 3 Question score no. 4 = 3 Question score no. 5 = 2 Total score = 11

Presenting mathematical statements orally, in writing, tables, pictures, and diagrams

a. Field Dependent (FD) category subject

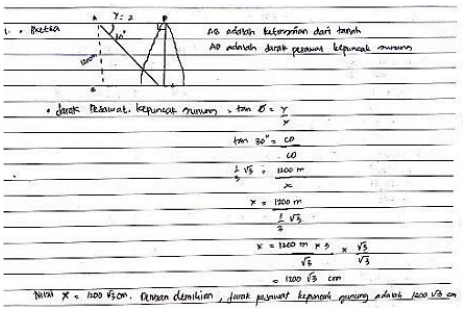

Figure 1. Answers to question number 1 (FD)

In Figure 1. it can be seen that the subject understands and is confident in solving the problem using the sin, cos, and tan formulas. By using a picture the subject understands the meaning of the question better. Moreover, in this case the subject of FD is in

accordance with the indicators of mathematical reasoning ability, namely being able to solve problems accompanied by pictures (Jami & Wijayanti, 2020). However, in the process the subject does not rewrite the existing information.

b. Field Intermediate (FDI) category subject

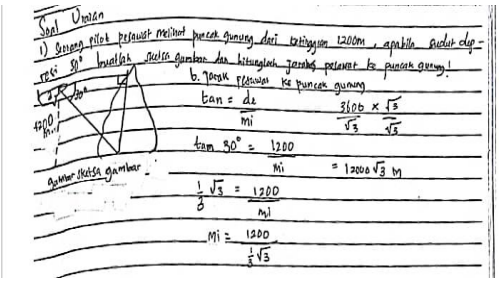

Figure 2. Answers to question number 1 (FDI)

Figure 2. The answer to the FDI category subject already understands about the problem and its solution using trigonometric formulas, so that the subject is confident in solving the problem. Answers accompanied by pictures make it easier for the subject to project what he has understood. Then the subject is in accordance with the reasoning indicators, namely presenting mathematical statements orally, in writing, tables, pictures, and diagrams (Jami & Wijayanti, 2020) . And based on the results of the interview, the subject knows what formula to use, it can be seen from the subject's answer regarding the trigonometric formula, in this case the subject gets an idea from what is observed so that he is able to answer the question. (Kramarski & Mevarech, 2003) .

a. Field Independent (FI) category subject

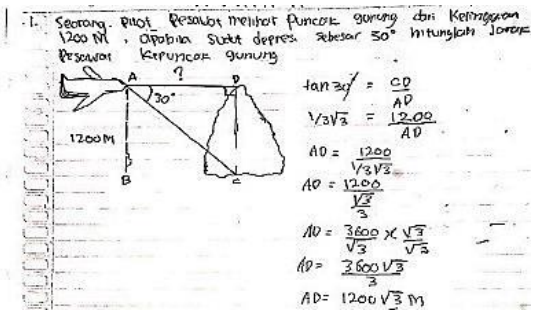

Figure 3. Answers to question number 1 (FI)

Figure 3. Subject answers in the FI category are quite understanding and know that the question is looking for side lengths with the formula sin, cos and tan. Subjects answered questions accompanied by pictures to make it easier to answer questions. So in this case the subject is sure of the answers that have been written. FI students are in accordance with the first indicator, namely presenting mathematical statements orally, in writing, tables, pictures, and diagrams (Jami & Wijayanti, 2020). In this FI subject, it can be seen that drawing airplanes and mountains in answering questions proves that the

FI subject really understands the problems in the problem. The characteristics of FI subjects tend to work independently and can criticize every problem (et al., 2018). Finding patterns or properties of mathematical phenomena to make generalizations.

a. Field Dependent (FD) category subject

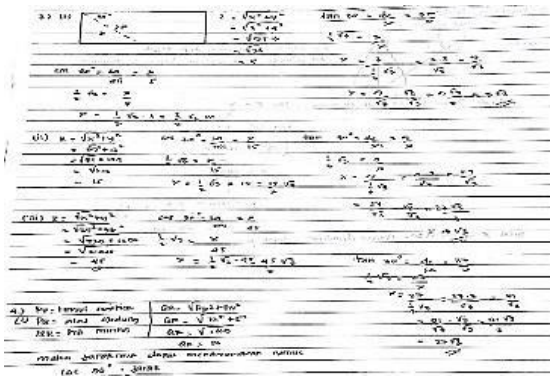

Figure 4. Answers to question number 3 (FD)

Figure 4 FD subjects understand a little about question number 3 that is looking for distance. With pictures on the subject matter it is easier to understand the problem. And when answering the question, the subject had time to think of another solution, namely the tan method, but the subject was not sure. So in this case there is an inconsistency in the subject of FD. In accordance with the findings that the characteristics of FD which tend to be non-selective in taking information from the environment and lack of self-confidence (Guisande et al., 2007).

b. Field Intermediate (FDI) category subject

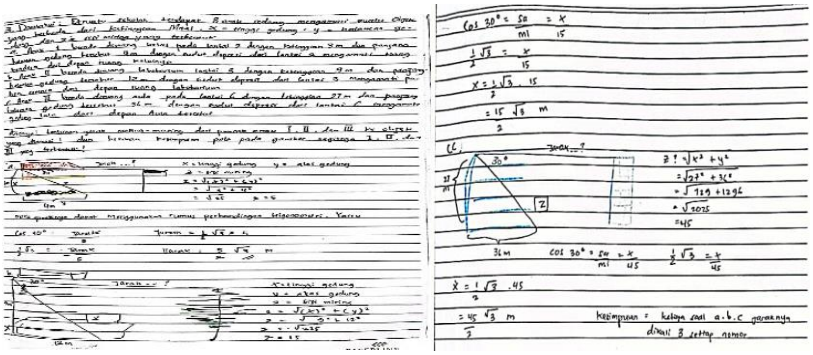

Figure 5. Answers to question number 3 (FDI)

It can be seen in Figure 5 that the subject is quite familiar with the problem so that he knows that the question is looking for distances using the Pythagorean and trigonometric formulas. In the questions there are pictures where the subject is easier to imagine and solve the problem. because the subject understands the question and is confident in answering the question, there is no other way or formula to think about. Therefore, the results of the mathematical reasoning ability of FDI subjects answer questions correctly and completely according to the indicators of mathematical

reasoning ability (Jami & Wijayanti, 2020). In accordance with research that the FDI category lies between independent and dependent who are characterized by having self-confidence and they can carry out the information obtained. (Valencia-Vallejo et al., 2018) .

c. Field Independent (FI) category subject

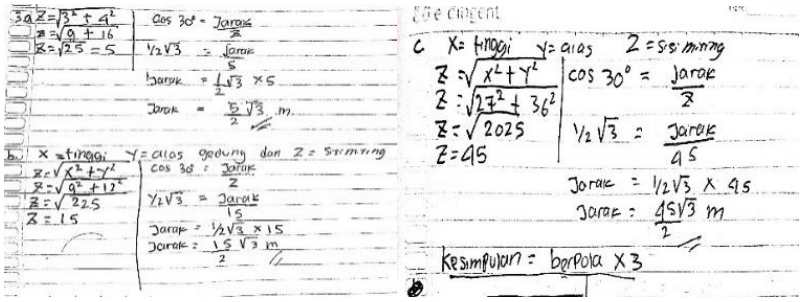

Figure 6. Answers to question number 3 (FI)

In figure 6, the subject of FI knows that the question uses the Pythagorean formula based on the picture. The picture makes it easier for the subject to answer questions where the question is looking for distance. However, in using other means the subject is unthinkable. So the mathematical reasoning ability of FI students is correct and appropriate based on indicators of mathematical reasoning ability (Jami & Wijayanti, 2020). However, here the subject does not rewrite the information contained in the problem and does not use other ways of doing it, such as using pictures.

Compile and provide reasons for the correctness of the solution

a. Field Dependent (FD) category subject

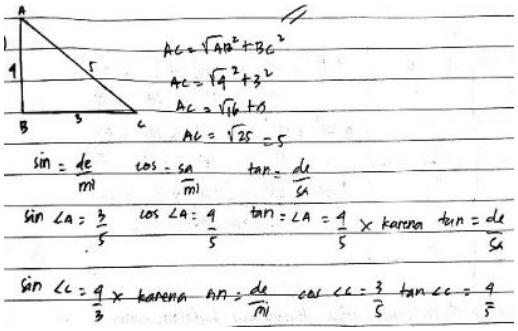

Figure 7. Answers to question number 4 (FD)

Based on the answer, the subject of FD knows that the question is about the angles of sin, cos, and tan so that the subject understands a little. Regarding solving the problem, the subject is quite sure of the answer, as can be seen from the subject's answer accompanied by a picture. Furthermore, in this case, according to the subject's answer, it is included in the score 2 on the scoring guidelines (Rodiah, 2019).

b. Field Intermediate (FDI) category subject

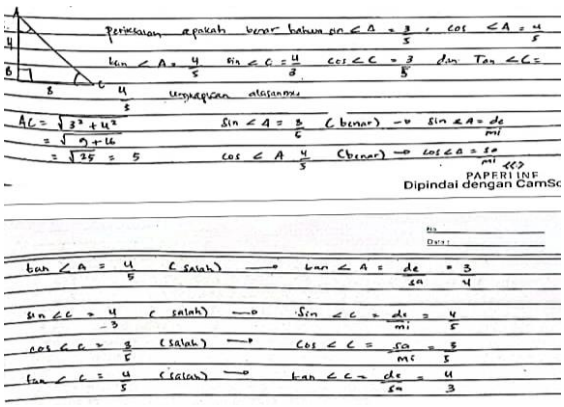

Figure 8. Answers to question number 4 (FDI)

The results of the FDI subject's answer in Figure 8 show that the subject understands where the questions about the angles of sin, cos, and tan are solved by giving a true or false statement. The understanding that the subject has makes the subject confident in answering the questions seen by the subject's answers which also use pictures in the solution. So in this case, it is correct and complete as can be seen from the answers to the mathematical reasoning ability test by rewriting the existing information and providing the truth regarding the answer. In this FDI subject, use the word wrong or right and show the correct answer to the solution. besides that it is supported by the answers of the subjects who are very confident in their knowledge and understanding, this is a characteristic of FDI (Valencia-Vallejo et al., 2018) . Based on the results of the subject's answer, it is in accordance with the indicators of mathematical reasoning ability, namely compiling and giving reasons for the correctness of the solution (Jami & Wijayanti, 2020) .

a. Field Independent (FI) category subject

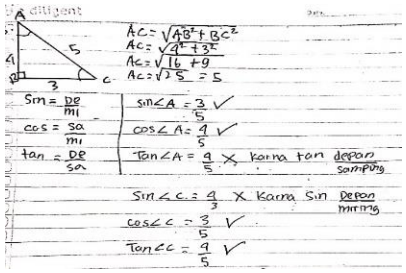

Figure 9. Answers to question number 4 (FI)

The answer to the subject of FI picture 9, the subject understands and knows that the problem contains a picture of a triangle which looks for trigonometric angles. The subject solves the problem with pictures so that the angles they want to look for can be seen. This makes the subject sure of the answer. However, in this case, apart from the subject not rewriting the existing information, the FI subject also did not provide the

correct solution for each answer seen in answers to tan A and sin C only. Students in the 3 scoring guidelines (Jami & Wijayanti, 2020).

Draw conclusions from logical statements

a. Field Dependent (FD) category subject

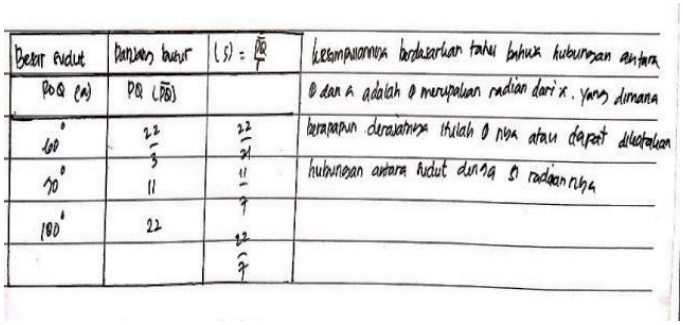

Figure 10. Answers to question number 5 (FD)

FD subjects don't really understand this problem, they only know that it's a matter of finding angles and arc lengths. The existence of the picture makes it easier for the subject to answer the question, but the subject is not sure about the answer. In the characteristics of FD that one of the influencing factors is external motivation (Ulya, 2015) . So that the FD answer is difficult to say as valid because it is not accompanied by a formula or steps in answering questions.

b. Field Intermediate (FDI) category subject

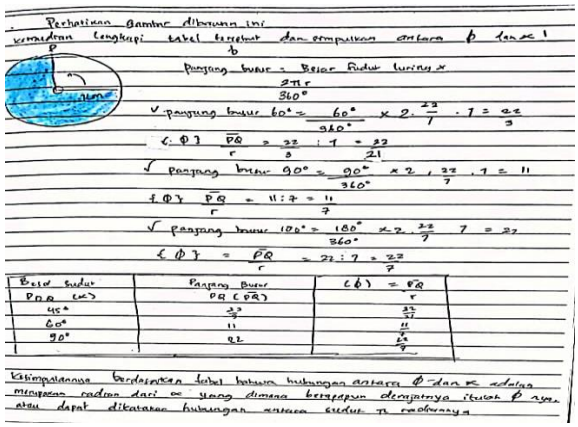

Figure 11. Answers to question number 5 (FDI)

Figure 11 FDI subjects understand the problem where the subject knows that the problem is finding angles and arc lengths and involves the square formula in solving it. With pictures on the questions, the subject understands and is interesting in thinking about solving answers. So in this case the subject is sure of the answer. In addition, based on the interview answers, it can be seen that the subject understands based on the knowledge he has and external influences, namely the teacher (Valencia-Vallejo et al., 2018) . In accordance with the characteristics of FDI, based on this, it can be seen that

the answers of FDI subjects are correct and complete in answering questions according to indicators of mathematical reasoning ability.

c. Field Independent (FI) category subject

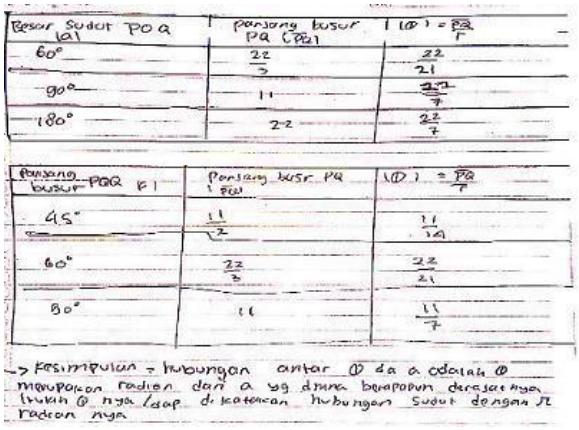

Figure 12. Answers to question number 5 (FI)

Based on the results of the FI subject's answer, it is quite understandable that the question is about angles and arc lengths. The presence of pictures on the questions is enough to help the subject in understanding the problem. So in this case the subject of FI is quite sure of the answer. In the characteristics of FD that one of the influencing factors is external motivation (Ulya, 2015) . So that the FD answer is difficult to say is valid because it is not accompanied by a formula or steps in answering the question. Furthermore, in this case, based on the scoring guidelines, the FI subject gets a score of 2 (Rodiah, 2019).

▪ CONCLUSION

Based on these results, one of the students' mathematical reasoning abilities is influenced by the category of students' cognitive styles. Students with mixed categories such as FDI have higher mathematical reasoning abilities. because students with FDI have the characteristics of FD and FI. This can be seen from the results in the table with a total FDI score of 15. In addition, based on the results of the interview, it can be seen that the answers of FDI subjects are more confident and confident in their answers. In contrast to the FD and FI subjects who answered questions and interviews with full doubts with a total score of 9 and FI subjects with a total score of 11 on mathematical reasoning abilities. So, in this case the teacher must pay more attention to the reasoning abilities of students in the FD, FDI, and FI categories according to their respective characteristics.

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