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Analysis of Students' Mathematical Understanding Abilities Based on Education for Sustainable Development (Esd) in Terms of Cognitive Style

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ABSTRACT

This study aims to determine the ability of students' mathematical understanding based on Education for Sustainable Development (ESD) in terms of cognitive style, and to find out which cognitive style students have the best ESD-based mathematical understanding abilities in learning mathematics. This research was conducted in class XI IPA 1 MA Tanwiriyyah. The method used is a quantitative descriptive method. The subjects in this study were 8 students with a purposive sampling technique. The instruments used were a cognitive style test (MFFT), an ESD-based mathematical understanding ability test, and interviews. The data analysis technique used is data reduction, data presentation, and drawing conclusions. Based on data analysis of ESD-based mathematical understanding ability students with reflective cognitive style obtained an average score of 81.00 in the moderate category, this was because students needed a long time to work on questions, and were not used to ESD-based questions. Impulsive cognitive style students get an average score of 42.45 in the medium category, this is because students tend to rush in working on questions, are less thorough, and are not used to ESD-based questions. Fast accurate cognitive style students get an average score of 93.25 in the high category. Whereas students with slow inaccurate cognitive style obtained an average score of 26.34 in the low category, this was because students needed a long time to work on questions, lacked mastery of the material, were less thorough, less interactive in learning, and were not familiar with ESD-based questions. So that students with the *fast accurate* cognitive style have the best ESD-based mathematical understanding abilities in learning mathematics, because they can solve math problems quickly, and the answers are correct, and obtain the highest average scores compared to students of other cognitive styles.

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INTRODUCTION

Mathematical understanding is one of the important abilities in learning mathematics. According to Wijaya et al. (2018) mathematical understanding is interpreted by students really understanding the material being taught not only as rote memorization, but students understand more about the concept of the material presented. If students have the ability to understand mathematics, it means that these students already know what they have learned, the steps taken, and can solve mathematical problems using various concepts (Nursaadah & Risma, 2018). So mathematical understanding has a very important role to measure one's knowledge of a material related to mathematics.

Students who have a poor understanding of mathematics, it will be difficult for these students to go to higher learning. This is in line with Khairunnisa et al. (2022) which states that the main goal in learning mathematics at school is that students have the ability to understand good mathematical concepts, so that they can continue higher learning. Therefore, understanding the concept which is part of understanding mathematics is one of the important goals in learning mathematics. The ability to understand mathematics also helps students to solve math problems in everyday life.

Mathematical understanding is the cornerstone of thinking in solving mathematical problems in everyday life, with an understanding student better understand the mathematical concepts being taught so that they no longer learn by rote but can apply them in various fields such as the environment, social and economics. Students through learning mathematics are expected to be able to prepare themselves to contribute to sustainable development through education or known as Education for Sustainable Development (ESD). ESD includes 3 main pillars, namely environmental, social and economic (Prabawani, 2021). Mathematics as a subject related to the environment, social and economics makes it important to study.

The importance of ESD values can be seen in Indonesia's situation which requires development or sustainable development, and students are not given space or time to relate learning material to phenomena or events around them. ESD needs to be applied in education in schools, namely by integrating ESD in learning, both in teaching materials such as practice questions related to ESD. However, in reality, ESD is not well integrated into schools, especially in learning mathematics. This is in line with the results of interviews by Marwa & Hamdu (2021) with several teachers, the results of the interview stated that teachers still did not know much about ESD, so education for sustainable development (ESD) was not much developed as a learning tool in schools. Therefore, in this study, applying ESD is included in math problems to provide more understanding and knowledge to students who are expected to have environmental, social, and economic awareness.

Based on findings in the field, when researchers carried out PLP (Introduction to Schooling Field) at one of the Cianjur High Schools, researchers found that there were

students who had difficulties in learning mathematics, especially understanding math word problems related to everyday life such as in the environmental, social, and economic fields which is part of ESD. While progress in the field of education continues to be made, especially in the development of more varied questions, many story questions are related to everyday life and have sustainable goals such as ESD-based questions. There are students' difficulties in understanding math problems related to environmental, social, and economic problems. This is because students only memorize formulas, and only follow the steps in the examples taught by the teacher without knowing how to convert word problems into mathematical form (Sari et al., 2022). In addition, students are not familiar with word problems related to environmental, social, and economic problems. As a result, students have difficulty if they are given questions of a different type. In line with the results of research by Junitasari & Hayati (2019) which states that students still have difficulty solving math problems with different types, this is what makes students' ability to understand mathematics low.

The low ability to understand mathematics is in line with the results of Handayani & Aini's research (2019) which showed that the low ability to understand mathematics was caused by students only memorizing formulas without knowing correctly the concepts and steps of the formula. Different research results were obtained by Wijaya et al. (2018) state that students' mathematical understanding ability is 70% and is classified as moderate. This shows that the ability to understand mathematics in students is different.

One of the differences in mathematical understanding abilities is related to the way students receive, store, and use information which is called cognitive style (Rahmawati, 2017). Every student has a different cognitive style, so processing information, how to respond or face a task, and solving problems are also different, some of which are fast, faster, and slower, and some are slower (Narianti & Masriyah , 2019). According to Happy et al. (2019) students with a reflective cognitive style are characterized by being slow in answering problems, but careful so that answers tend to be correct, while students with an impulsive cognitive style are characterized by being fast in answering problems, but not careful so answers tend to be wrong. Then students with a fast accurate cognitive style have characteristics that require fast time to solve problems and are accurate so that answers tend to be correct, while students with a slow inaccurate cognitive style have characteristics that take a long time to solve problems, but are inaccurate so answers tend to be wrong (Narianti & Masriyah, 2019). The cognitive style is a cognitive style based on the first-time students' answers and the accuracy of their answers.

Based on the research results of Styoningtyas & Hariastuti (2020) students' mathematical understanding of polynomial material in terms of reflective cognitive style is already good, because it can fulfill all indicators of mathematical understanding ability, whereas with an impulsive cognitive style, it is still not good because it does not

fulfill all indicators of mathematical understanding ability. Thus, the differences in the cognitive style of each student can certainly have a different impact on the ability to understand mathematics.

The difference between this study and previous research is that previous research only described students' mathematical understanding abilities, and only explained students' mathematical understanding abilities in reflective and impulsive cognitive styles only in high school students, whereas in this study the mathematical understanding abilities of ESD-based high school students were reviewed. from reflective, impulsive, fast-accurate, and slow inaccurate cognitive styles.

Based on this background, the researcher wanted to find out how the ability of ESD-based mathematical understanding of students with cognitive styles is reflective, impulsive, fast accurate, and slow inaccurate. This is intended so that the difficulties experienced can be identified so that researchers are interested in researching the analysis of students' mathematical understanding abilities based on Education for Sustainable Development (ESD) in terms of cognitive style.

MATERIAL AND METHODS

The research method used is descriptive quantitative. This research was conducted on 30 students of class XI IPA 1 at Madrasah Aliyah Tanwiriyyah for the 2022-2023 academic year. The sample in this study was 8 students, namely 2 students with a reflective cognitive style, 2 students with an impulsive cognitive style, 2 students with a fast accurate cognitive style, and 2 students with a slow inaccurate cognitive style. The sampling technique in this study used a purposive sampling technique. The criteria set for sampling in this study were (1) Selected students were able to communicate well when expressing opinions or ideas verbally or in writing based on recommendations from the mathematics teacher, (2) Students' desire to participate in data collection in this study.

The research instruments used were cognitive style test instruments, mathematical comprehension ability tests, and interviews. The data analysis technique used in this study is based on Sugiyono (2019), namely data reduction, data presentation, and concluding. The data collection process begins with giving the cognitive style instrument the Matching Familiar Figure Test (MFFT) which was designed by Kagan (1965) and then developed by Warli (2013) so that its validity and reliability have been tested, this instrument contains 1 sample item (experimental question) and 13 items questions to be filled in by students. Each question contains 1 standard image (standard/reference) and 8 variation images (answer options from standard images). MFFT is given to students one by one with the provision that if the student's answer is wrong then they are allowed to get the correct answer, after that each student calculates the average time to answer questions and the average frequency of answers, then the

researcher determines the median of the data obtained, namely the median time and the median frequency of student answers.

After obtaining the MFFT results, students are given an ESD-based mathematical understanding ability test instrument in the environmental, social, and economic fields with as many as 4 questions describing sequences and series material, before the test is used as a research instrument, the test questions are measured for validity related to language clarity, reductional, image clarity, construct validity related to the suitability of the questions with the indicators used, and content validity with the subject matter, goals to be achieved and aspects of ability measured by experts in this case the supervising lecturer. The results of the test questions are then categorized using the score limit formula adopted from Arikunto (2018), so that the ESD-based mathematical understanding ability value limits are obtained which are presented in table 1 as follows:

Table 1. Category of Assessment of Students' Mathematical Understanding Ability

Mathematical Understanding Ability	Information
$x \geq 83$	High
$31 < x < 83$	Medium
$x \leq 31$	Low

After analyzing the test questions, 8 subjects were selected from each of the 2 students' cognitive styles for interviews, the interview instrument was used to seek more information about students' ESD-based mathematical understanding abilities. The reason the researcher took 2 students each in each cognitive style, was because he assumed that the student's test results could be used as a comparison for material for analysis of each cognitive style. The selection of the subject of this study with the assumption that the errors experienced by respondents were the same as those experienced by other students.

The indicator of mathematical understanding ability used in this study is according to Kilpatrick et al. (2001) include: 1) Restate the concept that has been learned, 2) Classifying objects based on certain characteristics according to the concept, 3) Applying the concept algorithmically, 4) Provide examples and non-examples of the concepts that have been studied, 5) Presenting concepts in various forms of mathematical representation, 6) Associating various concepts (internal and external mathematics), 7) Develop necessary and sufficient conditions for a concept.

RESULTS

The selection of research subjects began with the administration of the MFFT cognitive style instrument. The summary of the MFFT results is stated in table 2 as follows:

Table 2. Summary of Student Cognitive Style Measurement Results

Class	The number of students	Time (Seconds)			Answer Frequency		
		Max	Min	Med	Max	Min	Med
XI IPA 1	30	82,20	29,66	47,04	3,15	1,62	2,69

Based on table 2, the results of measuring students' cognitive style tests were obtained with a median time of 47.04 and a median frequency of answers of 2.69. Then the results of the median time and median frequency of these answers will be used as the limit for grouping the four cognitive styles. For the provisions of the limit for cognitive style grouping, it refers to research conducted by Rosy, (2016), reflective students are taken from groups of students with the first time to answer (t) > 47 .04 and the frequency of answering until the correct answer (f) < 2.69, impulsive students were taken from the group of students with the first answer (t) < 47.04 and the frequency of answering until the correct answer (f) > 2.69. Meanwhile, fast accurate students were taken from a group of students with the first time to answer (t) ≤ 47.04 and the frequency of answering correctly (f) ≤ 2.69, slow inaccurate students were taken from a group of students with the first time to answer (t) ≥ 47.04 and the frequency of answering until the answer is correct (f) ≥ 2.69.

After analyzing the results of the cognitive style test measurements, it can be seen the number of students in each cognitive style, presented in Figure 1 as follows:

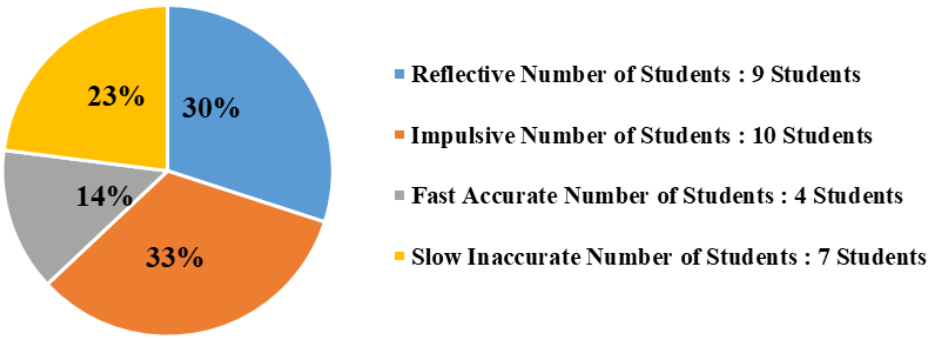

Figure 1. Number of Class XI IPA 1 Students Based on Cognitive Style

Based on Figure 1, the number of students with a reflective cognitive style is 9 students (30%), the number of students with an impulsive cognitive style is 10 students

(33%), the number of students with a fast accurate cognitive style is 4 students (14%), and the number of students with a slow inaccurate cognitive style is 7 students (23%). This shows that the proportion of students with reflective and impulsive cognitive styles is greater, namely 63% compared to students with fast accurate and slow inaccurate cognitive styles, namely 37%. From this data, 8 selected subjects were taken which are presented in table 3 as follows:

Table 3. Selected Research Subjects

Cognitive Style	Subject	Time (Seconds)	Frequency
Reflective	S5	48,12	1,92
	S6	49,51	2,08
Impulsive	S3	45,27	2,77
	S29	42,80	3,08
Fats Accurate	S13	46,27	2,46
	S25	29,66	1,69
Slow Inaccurate	S19	47,04	2,69
	S20	82,20	3,15

The results of the ESD-based mathematical understanding ability test in terms of cognitive style can be seen in table 4 below:

Table 4 Results Mathematical Understanding Ability Based on ESD in Terms of Cognitive Style

Cognitive Style	Many Students	Average Value	Mathematical Understanding Ability Category	Many Students (By Category)
Reflectif	9 Student	81,00	Medium	9 Student
Impulsif	10 Student	42,45	Medium	8 Student
			Low	2 Student
Fast Accurate	4 Student	93,25	High	4 Student
Slow Inaccurate	7 Student	26,34	Low	7 Student

Based on the results of the analysis of the data contained in table 4, it was found that the average value of students with a reflective cognitive style was 9 students, namely 81.00, including the moderate category, the average value of students with an impulsive cognitive style of 10 students, namely 42.45, included in the medium

category. While the average value of students with fast accurate cognitive style was 4 students, namely 93.25, including the high category, and the average value of students with slow inaccurate cognitive style was 7 students, namely 26.34, including the low category. This shows that students with the fast accurate cognitive style have the best ESD-based mathematical understanding abilities in learning mathematics, because they can solve math problems quickly, and the answers are correct, and obtain the highest average scores compared to students of other cognitive styles.

DISCUSSION

The discussion of the research results that will be described is the discussion of each research result that has been analyzed to achieve the objectives of this study, namely to determine the ability of students' mathematical understanding based on Education for Sustainable Development (ESD) in terms of cognitive style, and to find out which cognitive style students have the best ESD-based mathematical understanding skills in learning mathematics.

Based on the results of the study, the proportion of students with impulsive and reflective cognitive styles was greater, namely 63%, compared to students with fast accurate and slow inaccurate cognitive styles, namely 37%. These results are in accordance with several previous studies, research by Rahmatika et al. (2022) the proportion of students with reflective and impulsive cognitive styles is 70.8% greater than students with fast accurate cognitive styles and Slow Inaccurate 29.2%. The mathematical understanding abilities of ESD-based students based on cognitive style will be described as follows:

1. ESD-Based Mathematical Understanding Ability of Students' Reflective Cognitive Style

Based on the research results, information was obtained that the number of students with a reflective cognitive style was 9 students (30%) and the average score obtained by students with a reflective cognitive style was 81.00 which was in the medium category, this is in line with the research results of Abel & Susilowaty (2021) reflective cognitive style students are most dominant in the medium to high category.

Based on the results of the analysis of ESD-based mathematical understanding ability test questions, reflective cognitive style students only fulfill 5 indicators of mathematical understanding ability, including giving examples and non-examples of concepts that have been studied, classifying objects based on certain properties according to the concept, associating various concepts. (internal and external mathematics), and applying the concept algorithmically. In contrast to the results of the research by Styoningtyas & Hariastuti (2020) and Aprilia et al. (2021) students with a reflective cognitive style can meet all indicators of mathematical comprehension ability. This difference is due to the insufficient time needed to work on the questions, and students are not familiar with ESD-based math problems. In line with the results of Happy et al. (2019) which states that students with a reflective cognitive style tend

to make mistakes in writing formulas, processing errors, and require quite a long time, but are able to explain the intent of the answers written by them.

Based on the results of the interviews, according to students of the reflective cognitive style, the time needed to fill in the questions was not enough, this was because students of the reflective cognitive style often considered answers. In line with the research results of Rohmah et al. (2020) students of the reflective cognitive style are less agile in answering questions because they have to be based on deep thoughts, and the time required to answer long questions. In addition, when interviewing students with a reflective cognitive style, they think first before answering, but the answers given are clear and detailed. This is in line with the results of Fridanianti et al. (2018) students with a reflective cognitive style give correct answers, provide mature arguments, and think for a moment when answering questions. In line with the results of Wardani's research (2020) in understanding students' problems with the reflective cognitive style, they tend to find important elements and then write them completely and clearly. So the advantages of students with a reflective cognitive style are being thorough in working on questions, and the drawback is if it takes a short time to answer less agile, because they have to be based on mature thinking.

Then, based on the results of learning interviews that can be taken regarding education for sustainable development (ESD), students with a reflective cognitive style can express their solutions regarding the problems in the questions precisely and clearly, so that they are expected to realize the importance of ESD in the environmental, social, and economic fields.

2. ESD-Based Mathematical Understanding Ability of Students' Impulsive Cognitive Style

Based on the results of the study, the number of students with an Impulsive cognitive style was 10 students (33%), more than students with a reflective cognitive style. While the overall average score obtained by students with an impulsive cognitive style is 42.45 in the medium category. However, for students with impulsive cognitive style, after the question test was carried out, 2 categories were fulfilled, namely 8 students with an impulsive cognitive style in the moderate category and 2 students with an impulsive cognitive style in the low category. This is in line with the results of research by Abel & Susilowaty (2021) that students with an impulsive cognitive style are dominant in the medium to low category.

Based on the results of the analysis of tests of ESD-based mathematical understanding ability students in the moderate category of impulsive cognitive style only fulfill 2 indicators of mathematical understanding ability well, including giving examples and non-examples of concepts that have been studied and classifying objects based on certain properties according to the concept. In contrast to the results of Aprilia et al. (2021) that students with an impulsive cognitive style can fulfill indicators of classifying objects according to certain properties according to their concepts, providing examples and non-examples of the concepts being studied, and presenting concepts in various forms of mathematical representations. While the indicators link various concepts (internal and external mathematics), algorithmically apply concepts, apply concepts in various forms of mathematical representations. Students with

moderate impulsive cognitive style can fulfill these three indicators but there are still many errors. Then for the low category impulsive cognitive style, students can fulfill 2 indicators but there are still many errors. Among them are giving examples and non-examples of the concepts that have been studied, classifying objects based on certain properties according to the concept. This is because students tend to rush in working on questions, are not thorough, and are not familiar with ESD-based math problems.

Based on the results of interviews, students with an impulsive cognitive style are quicker in giving answers even though they tend to give answers that tend to be short and write down only what is in their minds when filling out the questions by not re-checking the answers that have been written by themselves. This is in line with the results of Fadiana's research (2016) that students with an impulsive cognitive style tend not to re-examine the solutions that have been found. In line with the results of the research by Jhahro et al. (2018) students with an impulsive cognitive style in filling in answers prefer to answer with simple answers that are not by the concept of the question rather than not answering them. The same research was conducted by Indah et al. (2021) which states that students with an impulsive cognitive style when answering questions do not re-examine the answers they get. In addition, during the interview, students with an impulsive cognitive style tended to repeat the questions asked by the researcher. In line with the results of Aprilia et al. (2015) students with an impulsive cognitive style in interviews can respond quickly and tend to repeat questions. So the advantages of students with impulsive cognitive styles are faster in answering questions, but the disadvantages are a lack of mastery of the material, less thorough in answering questions, then tend to be careless and rush in working on questions.

Based on the results of learning interviews that can be taken regarding education for sustainable development (ESD), students with an impulsive cognitive style can express their solutions clearly but more briefly when compared to students with a reflective cognitive style, but it is hoped that students can realize the importance of ESD in the environmental, social, and environmental fields. economy.

3. ESD-Based Mathematical Understanding Ability of Students' Fast Accurate Cognitive Style

Based on the results of the study, the number of students with the fast accurate cognitive style was 4 students (14%) less when compared to students of other cognitive styles. While the average value of students with fast accurate cognitive style is 93.25, it is in the high category. So that it can be said that students with the fast accurate cognitive style have the best ESD-based mathematical understanding abilities in learning mathematics compared to other cognitive styles.

Based on the results of the analysis, it was found that students with a fast accurate cognitive style can fulfill the 5 indicators of mathematical understanding ability well, including giving examples and non-examples of the concepts that have been studied, classifying objects based on certain characteristics according to the concept, associating various concepts (internal and external). external mathematics), apply the concept in various forms of mathematical representation, and apply the concept algorithmically. While the other 2 indicators can be fulfilled but not yet precise, meaning there are some mistakes. Even so, students with a fast accurate cognitive style

can immediately recognize mistakes and correct them. This is in line with Alfiana (2022) students with a fast accurate cognitive style are quick in giving answers without going through careful consideration, and the solutions given have errors but can be realized immediately so the answers tend to be right. The researcher also observed that when interviewing students with a fast accurate cognitive style, they could immediately understand the meaning of the questions given, and when there was an error in the answer, they could immediately realize and correct it again. Even though this word problem is associated with ESD problems, students with a fast accurate cognitive style can solve it well. Following the results of Annizar et al. (2018) states that students with a fast accurate cognitive style in identifying problems are by reading and understanding each term of the problem given in a short time, and being able to understand the intent of the problem given. This is in line with the research results of Narianti & Masriyah (2019) students with a fast accurate cognitive style can make a settlement plan that will be used to get solutions to solving problems in questions and determine the final answer along with clear reasons.

Based on the results of learning interviews that can be taken regarding education for sustainable development (ESD), students with a fast accurate cognitive style can express their solutions precisely and clearly. So it is expected to realize the importance of ESD in the environmental, social, and economic fields.

4. ESD-Based Mathematical Understanding Ability of Students' Slow Inaccurate Cognitive Style

Based on the research results, the number of students with a slow inaccurate cognitive style is 7 students (23%). While the average value of 26.34 is in the low category. Students with a slow inaccurate cognitive style also cannot fulfill all indicators of mathematical understanding abilities. This is because students can determine what is known and ask about the problem but the solution is not correct. Apart from that, there is a lack of mastery of the material, it is not thorough in answering questions, it is less interactive in learning, it takes a long time to answer questions, and students are not familiar with ESD-based math problems. This is in line with the results of Ramadanti & Syahri's research (2015) which states that students with a slow inaccurate cognitive style in giving answers only fulfill the problem planning stage, namely only to write down what is asked and know from the questions, and takes a long time.

Students with a slow inaccurate cognitive style in answering questions take a long time, answers are not quite right, and when errors are found they do not try to correct the answers they have written. This is in line with the results of Alfiana's research (2022) students with a slow inaccurate cognitive style take a long time to respond but are not accompanied by in-depth consideration, and when answering are not believed by themselves.

Based on the results of the learning interviews that can be taken regarding the problems of education for sustainable development (ESD), students with a slow inaccurate cognitive style can provide short but short answers. Nonetheless, it is hoped that students with a slow inaccurate cognitive style can realize the importance of ESD in the environmental, social, and economic fields.

5. The Cognitive Style that Has the Best ESD-Based Mathematical Understanding Ability in Learning Mathematics

Based on the research results, students with fast accurate cognitive style have the best ESD-based mathematical understanding abilities in learning mathematics because their average score is 93.25 in the high category, where fast accurate cognitive style students get the best ESD-based mathematical understanding ability test results compared to results of ESD-based mathematical understanding ability tests of other cognitive style students. In this study, the sequence of students who have the best ESD-based mathematical understanding abilities is based on their cognitive style, namely the first students with a fast accurate cognitive style, then students with a reflective cognitive style, students with an impulsive cognitive style, and finally students with a slow inaccurate cognitive style. This is because students with a fast accurate cognitive style can solve problems with questions in a fast time and with the right answers. In line with the results of Nurdianasari et al. (2015) the biggest increase in students' mathematical abilities was students with a fast accurate cognitive style, then followed by students with a reflective cognitive style, and impulsive, while the last was students with a slow inaccurate cognitive style.

Based on the results of students' research, the fast accurate cognitive style can solve problems in the right way. This is in line with the results of Ismiyati's research (2023) that students with a fast accurate cognitive style can solve problems correctly without careful consideration, and tend to write down everything that comes to mind on answer sheets with the right answers. In addition, the time needed to work on questions tends to be fast. This is because fast accurate students can organize their time well in filling out questions (Diana & Nurmawanti, 2020). Even so, in this study, the number of fast accurate students was less, namely 4 students. This number is the same as the results of Indah et al. (2021) which shows that there are fewer students with a fast accurate cognitive style, namely 4 students.

CONCLUSION

Based on the results of the study it can be concluded that the ability to understand mathematics based on Education for Sustainable Development (ESD) reflective cognitive style students obtained an average score of 81.00 in the medium category because it only fulfills 5 indicators of mathematical understanding ability, including being able to provide examples and non-examples from the concepts that have been studied, classifying objects based on certain properties according to the concept, linking various concepts (internal and external mathematics), applying the concept in various forms of mathematical representation, and applying the concept algorithmically. This is because students need a long time to work on questions, and are not familiar with ESD-based math problems.

The ability to understand mathematics based on Education for Sustainable Development (ESD) students of the impulsive cognitive style obtained an overall average score of 42.45 in the medium category. However, in the results of this study, students with an impulsive cognitive style fulfilled 2 categories, namely medium and low. Students with an impulsive cognitive style in the moderate category only fulfill 2 indicators of mathematical understanding ability well, including good mathematical understanding abilities, including giving examples and non-examples of concepts that have been studied and classifying objects based on certain properties according to the concept. Whereas the other 3 indicators of students with an impulsive cognitive style in the moderate category can be fulfilling but there are still many mistakes, including associating various concepts (internal and external mathematics), algorithmically applying concepts, and applying concepts in various forms of mathematical representations. Whereas students with a low category impulsive cognitive style only meet 2 indicators but there are still many mistakes, including giving examples and non-examples of the concepts that have been studied and classifying objects based on certain characteristics according to the concept. This is because students tend to rush in working on questions, are not thorough, and are not familiar with ESD-based math problems.

Mathematical understanding ability based on Education for Sustainable Development (ESD) students with fast accurate cognitive style obtained an average score of 93.25 in the high category because they can fulfill the 5 indicators of mathematical understanding ability well, including giving examples and non-examples of concepts that have been studied, classifying objects based on certain properties according to their concepts, linking various concepts (internal and external mathematics), applying concepts in various forms of mathematical representations, and applying concepts algorithmically. While the other 2 indicators can be fulfilled but not yet appropriate, including developing the necessary and sufficient conditions for a concept, and restating the concept learned. So students with a fast accurate cognitive style have the best ESD-based mathematical understanding skills in learning mathematics because they can solve math problems quickly and get the answers right, and get a higher average score than other cognitive style students.

Mathematical understanding ability based on Education for Sustainable Development (ESD) students with slow inaccurate cognitive style obtained an average score of 26.34 in the low category because it did not meet all indicators of mathematical understanding ability. This is because students need a long time to work on questions, lack mastery of the material, are not thorough, are less interactive in learning, and students are not familiar with ESD math problems.

As for suggestions for future researchers, it is suggested that the problems on the ESD-based mathematical understanding ability test questions are even more complex so that students' mathematical understanding can be seen. As for teachers, it is recommended to improve students' mathematical understanding abilities by giving

more ESD-based mathematics questions, and teachers pay more attention to each student's cognitive style in learning mathematics.

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