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Analysis of Students' Critical Thinking Abilities Using The PDEODE Strategy in Terms of Cognitive Style Through Online Learning

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Abstract. The existence of the Covid-19 pandemic in 2020 resulted in learning being carried out on-line. However, critical thinking skills are still honed in the learning process. The purpose of this study was to obtain a description of the critical thinking skills of students of Mathematics Education 2019, PGRI Ronggolawe Tuban University in the Environmental Knowledge course using the PDEODE strategy on the Reflective cognitive style and Impulsive cognitive style. This type of research is descriptive exploratory research. Data collection techniques used MFFT (Matching Familiar Figures Test (MFFT) and critical thinking ability tests. The research subjects were 12 students. The results showed that: 1) There were 5 students with a reflective cognitive style and 7 students with an impulsive cognitive style. 2) The average results of critical thinking skills for all aspects of critical thinking components in the reflective cognitive style group are: 40% for high category, 20% for moderate category, 40% for low category, while in the impulsive cognitive style group: 28.6% for high category, 28.6% for medium category, and 42.8% for low category. The conclusion is that the PDEODE strategy can be applied in online learning to empower critical thinking skills in terms of reflective and impulsive cognitive styles.

Keywords: Critical Thinking, PDEODE, Cognitive Style.

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1 Introduction

Learning about environmental knowledge materials for every student needs to be taught. In order to cultivate a habit of self, students' caring attitude towards ecosystem problems and the environment in which they live needs to be trained. Environmental knowledge material, if given to students of the Biology Education study program, is already familiar, but if this material is taught to students of the Mathematics Education Study Program it becomes something different. The condition of mathematics students who are accustomed to learning with abstract numbers and symbols needs to be mentally prepared when environmental knowledge material is taught. The presence of environmental knowledge material will make it burdensome, if in the mind of students they feel they will memorize a series of biological concepts full of Latin words. For this reason, in providing this material, it is necessary to provide an explanation in the delivery of the importance of studying environmental knowledge for daily student life, so that the material is more easily accepted, not only by memorizing concepts but fostering the ability to think critically.

Critical thinking is reflective, continuous and thorough thinking that can provide reasoning and systematic evaluation, and make decisions with confidence about what to do [1]. Having the ability to think critically is needed by students to solve problems in all areas of life. Critical thinking is very important to be honed in the learning process, in line with the demands of 21st century learning which require graduates to have competencies, one of which is critical thinking competencies. In the learning process, critical thinking skills should be used as a benchmark for achieving basic results. Critical thinking skills need to be optimized through the learning process, because aspects of critical thinking skills determine student learning success, especially cognitive aspects [2] .

To realize this condition, it is necessary to create meaningful learning by activating students in learning, namely students become student centered learning, and lecturers become facilitators, motivators, and guides, so that they can empower students' critical thinking skills. One of meaningful learning conditions is learning that is adjusted to the real conditions of students, so that the knowledge gained can be directly applied in their lives [3]. Thus it is necessary to have an appropriate learning strategy which gives students the opportunity to develop their ability to discuss, argue, develop ideas, ask and answer questions, draw conclusions, and decide something with scientific truth.

The PDEODE (Predict-Discuss-Explain-Observe-Discuss-Explain) learning strategy is a strategy consisting of various learning methods with six (6) stages, which contain student activities in carrying out activities as follows: *Predicting*, namely constructing new knowledge from previous experiences, *Discussing* with groups, in which there are questions asked, *explaining* the results of the discussion, and *observing* to seek scientific truth from existing data or facts, and *discussing* again to make decisions to make sure the observations are made, then draw conclusions by *explaining* again and making a follow up. PDEODE is a learning strategy that uses a constructivist approach, namely the process of forming new knowledge obtained by building up the initial knowledge that is owned from the natural phenomena around it [4].

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This strategy provides an opportunity for students to express their initial knowledge through discussions between friends in class [5]. Students will become more active, motivate each other between friends and interact with their groups, and be active in constructing their own knowledge. Through this learning strategy, students can have the opportunity to exchange ideas, communicate and give their opinions, make predictions, interpretations, and explanations in constructing their knowledge, and can correct their misconceptions through discussion and demonstration [6]. This of course can support meaningful learning. The results of research conducted to show that the application of the PDEODE strategy in the learning process is significant to improve students' critical thinking skills in Nutrition and Health subjects. The success of the PDEODE strategy is due to the fact that this strategy accommodates learning methods that can stimulate the increase in critical thinking skills[7].

In classroom learning there are different characteristics of students in terms of cognitive style. Cognitive style is a characteristic that a person has in accepting, responding, processing and solving problems. Distinguishes between cognitive abilities and cognitive styles. Ability refers to information that has been processed, and how it takes it and how it is processed, while style refers more to how to process information. Differences in cognitive learning styles should be a concern in implementing learning [8]. An important variable that can influence teacher and student choices in the academic field is cognitive style[9]. Thus, the characteristic factors of cognitive learning styles cannot be ignored in the learning process. Cognitive styles in this case are reflective and impulsive cognitive styles. Reflective students are students who have characteristics in answering questions slowly, but carefully, and their answers tend to be correct. Impulsive students are students who have characteristics in solving questions fast, but are less accurate, and the answers tend to be wrong [10]

There is no significant difference between students with reflective cognitive style and impulsive cognitive style students[11], but that students with reflective cognitive style are better at rules, patterns or logic to find truth, and in metacognition is more effective though less effective than students with impulsive cognitive style[12]. In line with this, the results of research show that learning that accommodates a reflective vs impulsive cognitive style can improve problem-solving abilities in mathematics[13]. Thus the learning strategy applied should be able to accommodate students with a variety of different cognitive styles. The application of PDEODE aims to empower critical thinking skills, in terms of differences in reflective and impulsive cognitive learning styles so as to produce positive results.

During the Covid 19 pandemic, learning was carried out online. Learning still aims to see students 'critical thinking skills by looking at the characteristics of students' cognitive styles. The strategy used is PDEODE, so that in its implementation, it continues to go through the stages in PDEODE using the Telegram platform. The objectives in this study were (1) to classify the cognitive learning styles of students in the Mathematics Education Study Program class of 2019, (2) to analyze the critical thinking skills of students in the Mathematics Education study program with the PDEODE strategy in terms of reflective and impulsive cognitive styles.

2 Research Methods

This type of research is descriptive expolative research. This study describes students 'critical thinking skills in the Environmental Knowledge course by applying the PDEODE strategy in terms of students' impulsive and reflective cognitive styles. The subjects of this

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study were students of Mathematics Education class 2019 at PGRI Ronggolawe University Tuban who took the Environmental Knowledge course in semester 2 consisting of 5 students with reflective cognitive style and 7 people with impulsive style. The selection of research subjects was determined based on cognitive style tests.

Data collection techniques: 1) Matching Familiar Figures Test (MFFT) to determine the cognitive style of the research subject, with the following steps: a) Students are given a Matching Familiar Figures Test (MFFT) sheet. This test contains one sample image and eight variation images[14], b) One of the exact same sample images for students to choose. This method is used to determine students who have a reflective and impulsive cognitive style. In measuring the cognitive style that was recorded, it was the first time the student answered (t) and the number of students' answers until they got the correct answer (f). Then the results of the student test are sought for the median or middle value by sorted first from the smallest number to the largest number then accumulated and presented in table form. The students are classified into reflective category (5 people), impulsive category (7 people), fast and accurate (3 people), and slow and inaccurate (2 people). However, in this study the research subjects were determined by the researcher with the impulsive and reflective categories only, 2) The critical thinking ability test. This method was carried out by giving a critical thinking test sheet in the form of a description of 5 questions which referred to the critical thinking indicator [15] which has been determined by the researcher. The test of critical thinking skills is done independently. The results of the critical thinking skills test were analyzed and classified after calculating the mean and standard deviation, categorized as very high, high, medium, low, and very low.

3 Results and Discussion

3.1 The MFFT test results are as follows

Table 1. Classification of Research Subjects.

No	classification	number of students	Percentage
1	reflective	5 persons	41,7%
2	impulsive	7 persons	58,3 %
	total number of students	12 persons	100%

In Table 1, it shows that there were more than 7 people in the Impulsive learning style category (58.3%) compared to 5 people who are in reflective category (41.7%). Thus it can be seen that in one class the characteristics of students have clear differences. It can be seen that children who have an impulsive cognitive style are quick to answer a problem, but are less accurate, so the answers tend to be wrong, so they are often careless [8].On the other hand, children who have a reflective cognitive style have the characteristic of being slow to answer problems, but careful, so that the answers given tend to be correct, because the person is very careful. However, it still possible that students with reflective cognitive style also may make mistakes.

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3.2. The test results of critical thinking skills

The results of the critical thinking ability test regarding environmental knowledge learning with the application of the PDEODE learning strategy for students who have a reflective cognitive style and an impulsive cognitive style can be seen in Table 2.

Table 2.Critical Thinking Ability Test Results and Mathematics Education Student Categories in the Environmental Knowledge Subject through the PDEODE Strategy in terms of Reflective and Impulsive Learning Styles

Code	Test Value CTA	Categories	Result (%)		
Reflective (R)					
			H*)	M*)	L*)
R1	85	high	40%	20%	40%
R2	82	medium			
R3	80	low			
R4	80	low			
R5	85	high			
Impulsive (I)					
			H*)	M*)	L*)
I1	80	low	28,6	28,6	42,8
I2	80	low			
I3	85	high			
I4	82	medium			
I5	82	medium			
I6	85	high			
I7	80	low			

*)H: high; M: medium; L: low

In Table 2.The results of the critical thinking ability test, after being categorized into very high, high, medium, low and very low, when viewed classically, namely by looking for the mean (average) with a standard deviation in reflective learning style there are 2 people in the high category (40%), 2 people in the medium category (40%) and in the low category one person (20%), while in the Impulsive learning style group for the High category there are 2 people (28.6%), in the medium category there are 2 people (28.6%), and in low category there are 3 people (42.8%). This shows that in the reflective and impulsive groups, they averagely gave short answers, so they did not reach the maximum score on the rubric. However, in both the reflective and impulsive cognitive style groups there are students in the High category.

Thus the application of the PDEODE strategy is able to empower critical thinking skills in both cognitive styles, reflective and impulsive groups. From their answer sheets, they were able to explain by describing the data obtained, giving ideas or opinions on how to provide solutions, draw conclusions, and do an action that should be done. They work with a long process flow to get the correct answer. For those in the low category, students are not used to being in the discussion, to actively ask questions and actively answer questions, because it was still found that only certain students dominated the discussion. Judging from the individual value, both the Reflective and Impulsive groups, each individual is ≥ MCC (Minimum Completeness Criteria) which is 80. Thus it can be interpreted that the application of the

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PDEODE strategy can accommodate the ability to think critically both in groups with reflective cognitive learning style and Impulsive cognitive learning style.

The PDEODE strategy has six activity steps which are a flow in the learning process, starting with predictions that give students the opportunity to construct their knowledge from the experiences they have before learning, for example about "global warming", students already have prior knowledge, from various reading sources, so that when entering into a discussion about the meaning of global warming, the factors that cause global warming. the impact on human life, solutions to overcome global warming, and what follow-up will be done, students can discuss it in a series of PDEODE steps to discuss, explain, and observe, so that after the observation step, students go on into discussion activity and explain again, they are trained in asking questions and answering questions asked.

This activity involves students being active. Learning becomes meaningful, so that it can empower critical thinking skills. This is in accordance with Costu,who states that learning can improve critical thinking skills, namely by active learning [4]. Similarly, stated that student-centered learning will be able to develop critical thinking skills [16].

The aspect of providing a simple explanation in the critical thinking assessment rubric shows that knowledge in the form of concepts that students have needs to be shared with others, so that they get responses, input and suggestions, and will develop new concepts and new ideas. The activities of asking, answering, arguing, and conveying ideas facilitate the improvement of critical thinking. The discussion method is an effective way of developing critical thinking skills. With this in mind, students who have reflective and who have impulsive cognitive styles with the application of PDEODE are facilitated to be able to develop their critical thinking skills [17] [18].

4 Conclusion

Empowering critical thinking skills is a must in the learning process. However, it is no less important to pay attention to differences in student characteristics in terms of cognitive learning styles, namely reflective and impulsive, so it is necessary to have a learning strategy that can accommodate these conditions. The PDEODE (Predict-Discuss-Explain-Observe-Discuss-Explain) strategy can be used as an alternative in order to empower students' critical thinking in terms of reflective and impulsive cognitive styles.

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