

Application of the Scientific Approach Using Guided Inquiry to View the Ability of Critical Thinking Students

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Abstract. This study aims to describe the application of a scientific approach using guided inquiry and see the level of critical thinking skills of students in Social Statistics courses. This type of research is descriptive with a qualitative approach. Data collection methods in. This study uses observations and tests. Data obtained from 60 students. The results showed that the application of the scientific approach using guided inquiry in Social Statistics courses can be carried out following the learning steps that have been prepared with an average student activity of 80%. Student learning activities during learning are categorized as good, with details of activities observing, reasoning, trying and communicating the same category which is good, while the questioning activity is quite good. Students' critical thinking skills as a whole are classified as very good, with details that are classified as high in the aspects of identifying the assumptions given, and in good categories on the indicator of revealing data/definitions/ theorems to solve problems and evaluating aspects in solving problems.

Keywords: Scientific Approach, Guided Inquiry, Critical Thinking

1 Introduction

Effective mathematics learning is learning that involves students maximally or is student-centered. Because in mathematics can be defined as a communication system for the concept of shape, size, quantity and order used to describe various phenomena both in physical situations and others [1]. In general, student-centered learning is active learning that involves students in physical activity or mentally in thinking [2]. To make students directly involved in learning activities and to achieve the ideal learning in mathematics learning, it is necessary to improve all learning components. One such component is the role of an teacher [3]. ducation in Indonesia which includes mathematics, science, and technology is undergoing major reforms in curriculum design including teaching strategies [4]. s a teacher, lecturers need to use the right strategies and methods in learning mathematics. Because the method not only serves as a way to deliver the material, but also as an effort to increase student activity and practice critical thinking skills on concepts in mathematics learning. For example, is a strategy to explain and give questions orally. Asking questions can be used as a teaching strategy in itself, or as part of another strategy [5]. In addition, lecturers are also required to understand various learning approaches in order to be able to guide students optimally [6].

The learning approach developed in the 2013 curriculum is a scientific approach. In this approach, material is based on phenomena or facts of daily life. Therefore, as a lecturer

facilitator must have the ability to understand students with a variety of uniqueness in order to be able to help students deal with learning difficulties. By applying this approach in mathematics learning, it is expected to be able to increase student activity and critical thinking skills, so that it will affect student learning outcomes in mathematics. The ability to think critically is how individuals think habits from experience and learning, not from what they can suddenly. Critical thinking has become one of the tools used in our daily lives to solve several problems because it involves logical reasoning, interpreting, analyzing and evaluating information to enable someone to make a valid decision [7]. Critical thinking emphasizes the importance of planning strategies in solving problems in various ways, providing ideas, and comparing solution strategies with students' previous experiences or theories [8]. The components of critical thinking skills are analyzing, making comments, self-regulation, identifying assumptions, explanations, and evaluations [9].

Based on observations on learning in class, students have difficulty when asked to observe the material in the student guide book. In addition, students also have difficulty when given exercises that are different from the examples given by the lecturer. Lecturers do not use varied methods and group discussion is not carried out in the learning process. So that student activities in learning mathematics are dominated by the same students. Only 8 out of 32 students are active in the class. Cognitive students are still difficult to be active in learning mathematics. This is seen from students who are only silent (passive) when the lecturer gives questions or problems. Approximately 30.00% of students responded to questions from lecturers. The critical thinking ability of students is also still lacking, seen from the value of students' skills in doing math tests in the form of essay questions achieving mastery learning 50.00%.

From the problems above, the less optimal learning of mathematics is triggered by lecturers and student factors. Given the importance of mathematics, efforts are needed to overcome problems in learning. Namely by applying a scientific approach and guided inquiry methods in learning mathematics. The scientific approach and the guided inquiry method can make students active in class by directing them to think for themselves discovering the concepts of the material to be learned.

Scientific approach according to Abidin [10] is a learning model that is based on a scientific approach to learning that is oriented to fostering students' ability to solve problems through a series of inquiry activities that demand critical thinking, creative thinking, and communication skills in an effort to improve student understanding. Scientific approach by [11] is an approach that emphasizes analysis and synthesis, analogy, abstraction, and concretization, generalization and specialization, induction, and deduction. The steps include Observing, Questioning, Associating, Experimenting, and Networking. In order for a scientific approach to learning mathematics to run well, it is necessary to have new innovations by combining the scientific approach with one of the learning methods. The method is a guided inquiry method. The scientific approach will be effective if applied using the guided inquiry method, because they both build student activities to solve problems through critical thinking.

The guided inquiry method involves maximum student activity to search and investigate systematically, critically, logically, so that students can formulate their own findings with confidence [12]. Inquiry-based learning (IBL) aims to develop and grow thoughts and attitudes to ask questions and enable students to face and manage thinking [13]. Basically the guided inquiry method places students as study subjects. In the learning process students not only act as recipients of the lesson through lecturer explanations, but students are directly involved in the process of finding the concept. During the discovery process, students get lecturer guidance in the form of verbal or written instructions as outlined in the form of student worksheets. The guided inquiry method is also good for practicing students' critical thinking skills. So the guided

inquiry method makes students more understanding in mastering the material, can improve students' ability to think critically, and student activities in the classroom become more meaningful.

Based on the problems obtained, the purpose of this study is to describe 1) the application of a scientific approach using guided inquiry in mathematics learning, 2) the level of student activity in learning mathematics with a scientific approach using guided inquiry, 3) the level of critical thinking ability of students in mathematics learning mathematics with scientific approach using guided inquiry.

2 Method

This study aims to describe the application of a scientific approach using guided inquiry in learning social statistics and how students' learning activities and critical thinking skills in mathematics. Data collection methods using observation and tests. While the instruments used are observation sheets and tests. Observation is used to see the implementation of the activities of lecturers and students when learning takes place. The test is used to determine the level of students' critical thinking skills in mathematics. The procedure of this research is divided into three stages: the planning stage, the implementation phase, and the research report preparation stage. The analysis of this research uses descriptive research with qualitative and quantitative approaches.

3 Result and Discussion

The results and discussion discussed are related to the application of a scientific approach using guided inquiry in social statistics learning, learning activities and students' critical thinking skills in mathematics. The implementation of social statistics learning by applying a scientific approach using guided inquiry can be seen from the learning activities of students.

Table 1. Student Activities.

Aspect	Meeting to-			Average
	I	II	III	
Observing	80	75	80	78,33
Questioning	68	75	75	72,66
Associating,	75	68	100	81
Experimenting	75	80	80	78,33
Networking	83	75	83	80,33
Average	76,2	74,6	83,6	78,13

Table 1. Explain student activities in learning social statistics by applying a scientific approach using guided inquiry. The first student activity is observing which consists of only one indicator. Activities on the observing aspect at the first and third meetings received the same score of 80. However, at the second meeting decreased by a percentage of 75. From the first meeting to the third overall average score of observing activity was 78.33 which was classified as good category.

The second type of student activity is asking questions which are divided into two indicators, namely making questions from the observed object and conducting question and answer with lecturers about things that are not yet understood. The first meeting got the lowest score of 68. Whereas the second and third meetings got the same score. Overall the average questioning activity was 72.66 with a fairly good category.

The third type of student activity is reasoning which consists of two indicators, namely digging information related to the material and discussing with the group to look for and find concepts from the problems given. In the first meeting the total score obtained was 75 in the good category, while in the second meeting the number was decreased by 68 in the good enough category. Whereas at the third meeting again experienced an increase with a perfect score that is 100 with a very good category. So as seen from the average student activity in reasoning as a whole from the first meeting to the third is 81 classified as good category.

The next assessed activity was a try activity consisting of two indicators, namely trying to work on the problem to prove the truth about the concept of the results of the discussion that had been carried out to get a consistent score of scores at each meeting. The second indicator is to do the exercises as a concept maturation. The total score at the first meeting was 75 and at the second and third meeting the total score obtained was stable at 80 in the good category. While the total score of students' activities in trying as a whole from the first meeting to the third was 78.33 in the good category. The results of the activity score try the same as the results of the observing activity scores which are classified as good.

The next assessed activity is the activity of forming a network / communicating consisting of three indicators, namely concluding the results of the discussion, presenting the results of the discussion in written form, and presenting the results of the discussion in front of the class. In the first and third meeting got the same score of 83 in the good category and the second meeting scored 75 in the good category. The score of student activity in forming the overall network from the first meeting to the third was 80.33 classified as good category. In general, student activities during the process of learning mathematics by using a scientific approach using guided inquiry runs well. The type of activity that gets the highest score is reasoning with the acquisition of 81 in the good category, while the lowest score is found in the questioning activity with the acquisition of 72.66 which is included in the good category as well.

Here are the results of the analysis for students' critical thinking skills in learning social statistics.

Table 2. Critical Thinking Ability of Student Mathematics.

		or			
Identify the assumptions given	a. Knowing and writing things that are known and asked questions in the form of mathematics	-			96,24
	Average	91,40	92,96	-	96,24
The ability to reveal data / definitions /	a. Can understand the concept of comparison by using tables, graphs, and equations.	82,81			84,52

	theorems in solving problems	b. Using the concept of comparison in solving problems		82,43	85,46
		Average		82,62	84,99
The ability to evaluate in solving a problem		a. Perform calculations systematically and correctly	83,59	85,93	86,52
		b. Write the conclusions of the answers worked on	82,81	-	75,62
		Average	85,88	83,2	85,93
Overall average			87,60	85,74	84,27
					87,43

Students' critical thinking skills can be known through the results of quizzes in the first to third meetings and student evaluations at the last meeting. The results of the analysis state that, the ability to think critically the first student is to identify the assumptions given which consist of 1 indicator. The indicator is to know and write things that are known and asked about questions in mathematical form. At the first meeting the score was 91.40. While at the second meeting the students were getting used to identifying the problems given so as to obtain an increase in score of 92.96. At the third meeting the first aspect was not used, and the test questions identified the problem again used for the assessment of critical thinking. Seen to be an increase in students who are able to identify problems by writing things that are known and asked questions that score 96.24 in the excellent category.

The second step of critical thinking is the ability to express data / definitions / theorems in solving problems. The first indicator is to be able to understand the concept of comparison by using tables, graphs, and equations. At the first meeting, a score of 82.03 was classified as good. The obstacle in this meeting 1 is that students directly work without any concept that can be connected in solving problems. Whereas in the second meeting decreased with the acquisition of a score of 80.92. In contrast to meetings 3 and 4 experienced an increase again, namely at meeting 3 with a score of 82.81 and meeting 4 the results of the evaluation test obtained a score of 84.52 where students have been able to understand the concept of comparison in solving problems with both included in both categories.

The next indicator is to use the concept of comparison in solving problems with the lowest score obtained at meeting 2 is 81.25. The obstacle in Quiz 2 is that students directly work on the questions without using a formula of comparative worth, while at the 3rd meeting students are still fixated on the example so that in connecting the concept with the problem there are still errors but an increase in score is 82.43. For meeting 4 namely the test to get a score of 85.46 it is seen students are able to use concepts or relate them to existing problems and understand the concepts that will be used in accordance with the problem. The acquisition of a meeting score of 4, the results of the critical thinking evaluation test belong to the very good category.

The third critical thinking ability is the ability to evaluate in solving a problem consisting of 2 indicators. The first indicator is to carry out systematic calculations. At meeting 1 the acquisition score of 92.87 which is classified as very good category, but at meeting 2 decreased by 83.59. This happens because students return to work directly in a quick way and there are some incomplete in solving problems so the process is not systematic. Meeting 3 and meeting 4 during the evaluation test showed that students could present systematically and precisely which continued to increase from 85.93 to 86.52 which was classified as very good category.

The last indicator that exists in the ability to think critically is to write the conclusions of the answers worked on. This indicator is in quizzes 1, 2 and tests. The lowest score is on the test

results with a score of 75.11 in the good category. The obstacle in this 4th meeting was that students did not write a conclusion on the final answer even though the answer was correct. Previous meetings, namely meetings 1 and 2, increased from 78.9 to 82.81. Meeting 1 is the obstacle that students are not accustomed to writing conclusions at the end of their answers and meetings 1 and 2 belong to the good category.

Based on the table and information above obtained from the first meeting to the fourth meeting to score critical thinking skills have decreased and increased. The decline occurred at meetings two and three. The decline in the second meeting occurred because students returned to the habit of working out of accordance with procedures and students preferred to work directly, while in the third meeting decreased because there were 2 indicators not included in the assessment, namely indicator 1 and the last indicator. But on the test there was an increase of 87.83 which was categorized as very good and overall the critical thinking skills of students from meetings 1 to 4 were classified as very good.

Previous research conducted by [1] show that students who are taught logic using guided inquiry teaching have better achievement scores than students who are taught using conventional teaching methods. Research by [14,15] about The Enhancement of Students' Critical Thinking Skills in Mathematics through The 5E Learning Cycle with Metacognitive Technique also states that in general students' critical thinking processes are better when compared to conventional methods. Based on the results of this study and previous research it can be said that certain learning methods can be used to see the level of critical thinking skills of students. So that in learning should use learning methods that are consistent with the material being taught.

4 Conclusion

Based on the results of research that has been carried out on the implementation of learning, and the activities of lecturers and students' critical thinking skills by applying a scientific approach using guided inquiry, it can be concluded that the application of the scientific approach using guided inquiry in social statistics courses for 3 meetings as a whole can be carried out well. The level of student learning activities on learning using the Scientific and Guided Inquiry approach is categorized as good with a score of 78.13, with details of the level of activity of observing, reasoning, trying, and communicating the same categories which are good. While the questioning activity level is quite good with a score of 72.66

The level of students' critical thinking skills in mathematics showed very good results from each meeting with the acquisition of a score of 87.09 with details categorized very well with a score of 94.21 is on the aspect of the ability to identify the assumptions given, while the good category is on the aspect of the ability to reveal data / definitions / theorems and aspects of the ability to evaluate in solving problems.

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