Analysis ability thinking fluency of students in global warming materials through inquiry learning model

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Abstract. Fluency thinking is a process of fluency in giving arguments that refers to the many acceptable responses to knowledge. This research aims to describe how the implementation of the guided inquiry learning model and describe the ability to think fluency of students on the material of global warming after being given guided inquiry learning. The research design used one group pre-test post-test design. This study utilised essay questions to measure level the thinking fluency of students. From this research, it was concluded that the implementation of guided inquiry model learning was in good category and the ability to fluency thinking of students has increased by 22.32% which was marked when students communicate many ideas. It is highly recommended to the another researcher to utilise Inquiry Learning Model to increase students' fluency thinking abilities.

1. Introduction

In the information technology industry 4.0 today, everyone both students and teachers in schools, including at the high school level, are required to continue to adjust to technological advances that have been explored throughout the world. The results of the progress of information and technology have resulted in everyone including the government, teachers, and students. They have to think creatively by wanting to learn to make changes in a positive direction. These changes resulted in the government's educational curriculum policy. The current education curriculum requires students to play an active role in the learning process [1]. Active learning requires students to be able to process their way of thinking. These abilities include the ability to think actively, think creatively, and think critically, and can communicate any ideas or ideas in the face of the industrial revolution (IR) 4.0 era [2].

Teach students' creative thinking skills in learning is very important to fulfil the demand for IR 4.0 [3]. Students' creative thinking skills are the ability to convey ideas or ideas according to their perspectives and knowledge [4]. Creative thinking skills are divided into four aspects, namely fluency, flexible thinking, original thinking, and detailed thinking (elaboration) [4-5]. Creativity is the root of innovative thinking that leads to new and useful solutions or products. Someone's creativity can be seen through how someone can convey their arguments or creative ideas. Based on these explanations, a person can be said to be creative if they can convey arguments well or are able to communicate well in accordance with their new ideas. Candige's study stated that 15% of workers lay off due to a lack of ability to communicate well. This is due to a lack of communication or to use the ability to argue fluency with the leaders and colleagues.

Fluency thinking skills have a smooth process in providing arguments that refer to the number of responses that can be received to knowledge [5]. The ability to think fluently was one aspect of creative thinking skills. In a learning process, student activities and teacher facilities are needed to be able to make the classroom come alive. But the facts obtained show that most students in learning are passive, while the active ones are teachers. To involve students' activities in the learning process can be done by using scientific activities, experimental activities, or scientific investigations so as to be able to practice their thinking skills fluency.

Learning by using these scientific activities is Guided Inquiry. Guided Inquiry was a learning model that involves all students' abilities to search and solve problems critically, logically, and analyze to find a problem with the guidance of the teacher [6]. The steps of guided inquiry are 1. present a question or problem; 2. propose a hypothesis; 3. design an experiment; 4. conduct an experiment to obtain information or data; 5. collect and analyze data; 6. make conclusions. Through the guided inquiry learning model, students can be trained to think fluency [7, 8]. Smooth thinking in question is to provide an argument or opinion on existing problems.

2. Method

This type of research uses quantitative descriptive pre-experimental design research, because it uses replication groups [9]. The study was conducted at 11th grade science class in senior high school, involving 1 experiment group and 2 replication groups. The research design used was one group pre-test post-test design, as in Figure 1.
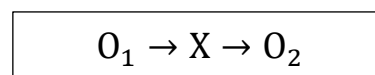
$$O_1 \rightarrow X \rightarrow O_2$$

Figure 1. Research design.

Information:
O1   : Pre-test (giving a test of thinking skills fluency before being treated)
X   : Students are given treatment that is the application of guided inquiry learning models using the material on global warming
O2   : Post-test (giving a test of thinking skills fluency after being treated).

Data collection was done by providing pre-test and post-test questions about global warming material that directs students to be able to answer questions fluency or think fluency. The test method was carried out twice, namely pre-test at the beginning of learning and post-test at the end of learning after the guided inquiry model is applied. Test questions given by students are only one question. The question reads "explain the meaning of global warming".

The data obtained have the results of tests of creative thinking skills. The results of the pre-test and post-test were analyzed using prerequisite tests namely normality test, homogeneity test, then paired *t-test,* and n-gain analysis.

3. Results and Discussion

The implementation of learning was used to measure the success of researchers in completing each phase of the syntax of guided inquiry models. The inquiry learning model was applied to 1 experimental class and 2 replication groups. Overall, the implementation of the guided inquiry learning process was assessed by two observers through a questionnaire on the implementation of learning. The results of the three groups have been recapitulated through the table below:

Table 1. Recapitulation of the implementation of guided inquiry learning.

Learning Activities	Score			Category
	Experiment	Replication 1	Replication 2	
Introduction	3.75	3.75	3.75	Very Good
Core Activities	3.20	3.22	3.29	Very Good
Closing	3.33	3.33	3.33	Very Good
Average		3.43		Very Good

Table 2. Gain score analysis of thinking skills fluency.

Number	Group	$N<g>$	Category
1	Experiment	0.81	High
2	Replication 1	0.51	High
3	Replication 2	0.65	Medium

Through simple laboratory activities and scientific performance, researchers have been able to apply it well in each of the experimental groups. In 2014, a group of researcher [10] showed that through guided inquiry-based learning was able to improve students' scientific performance in analysing data. In the research also resulted that the experimental-based learning process has resulted in an average achievement score higher than conventional learning [11], and it can improve critical thinking skills [12]. After the implementation of guided inquiry learning has carried out by the researcher, the students are given a post-test problem. The results of the pretest-posttest score were calculated through a normality test, and a homogeneity test and the sample was normally distributed and declared homogeneous so that a paired t-test could be performed. In all three groups, H_0 was declared rejected, and H_1 was accepted. Then, to find out the results of the pre-test and post-test essay questions about smooth thinking skills of students from the three groups are calculated with the gain score as follows:

From the table above we get the gain score of the three classes in the high and medium categories. This results in line with research by Kirana and Madlazim [13], who stated that through the guided discovery learning model, creative thinking skills have resulted in an n-gain of 0.86 with a high category. Analysis of students' current thinking skills through the question that reads "Explain the meaning of global warming". The question has various answers that are adjusted through 3 answer criteria. The correct answer from the statement above was the increase in the average temperature of the earth's surface [14], caused by negative human activities such as the cutting down of trees, the use of motor vehicles and so on, causing greenhouse gases in the earth's atmosphere to increase [15]. From these answers, it can be found 3 main aspects that must be answered by students so that the answer was considered correct. The three aspects of the answers are 1) if the student answers correctly, 2) explains the cause correctly, and 3) explains the effect correctly. Thus if students could answer all three correctly then they are entitled to get a perfect score for question number 1 which was a score of 8-10.

If the students have answered correctly, explained the cause correctly, but did not explain the effect correctly, a score of 6-7 was obtained. Then, if students have answered the question correctly, but do not explain the cause and effect of global warming correctly, a score of 1-5 was obtained. Table 3 below summarizes variations in the answers of students in Experiment class for questions number 1 above and their categories. Table 4 summarises variations in the answers of students for the same questions in replication 1. Then, Table 5 summarises variations in the answers of students for the same questions in replication 2.

Table 3. Results of pre-test and post-test experiment group on the questions with indicators of fluent thinking.

Criteria number	Assessment criteria	Number of students answering according to the criteria		Category
		Pre-test	Post-test	
1	Answering correctly, but not explaining cause and effect Score: 1-5	8	0	Below the standard
2	Answering correctly, explaining the cause correctly, but not explaining the effect Score: 6-7	22	4	Current
3	Answer and explain cause and effect correctly Score: 8-10	2	29	Very fluency

Table 4. Results of pre-test and post-test replication 1 on the questions with indicators fluency.

Criteria Number	Assessment criteria	Number of students answering according to the criteria		Category
		Pre-test	Post-test	
1	Answering correctly, but not explaining cause and effect Score: 1-5	8	0	Below the standard
2	Answering correctly, explaining the cause correctly, but not explaining the effect Score: 6-7	22	4	Current
3	Answer and explain cause and effect correctly Score: 8-10	2	29	Very fluency

Table 5. Results of pre-test and post-test replication 2 on questions with indicators fluency.

Criteria Number	Assessment criteria	Number of students answering according to the criteria		Category
		Pre-test	Post-test	
1	Answering correctly, but not explaining cause and effect Score: 1-5	2	0	Below sub standard
2	Answering correctly, explaining the cause correctly, but not explaining the effect Score: 6-7	28	0	Current
3	Answer and explain cause and effect correctly Score: 8-10	3	34	Very fluency

Based on the data in Table 3 to Table 5, it can be concluded that the smooth thinking skills of students in experiment class for answers to questions between pre-test and post-test were very different as a result they are treated in the form of guided inquiry learning. Before being given the treatment of guided inquiry learning (pre-test), in criterion 3 there were only 2 students who were able to answer and explain the causes and causes of global warming correctly, but after being treated (post-test), the number of students who were able to answer right and explain the cause and effect has increased to 29 people. In other words, the treatment has a positive effect on the students' current thinking skills.

For criterion number 1, before being given a guided inquiry treatment (pre-test), there were 8 students who were able to answer correctly but did not explain cause and effect, but after being treated (post-test) there were no students who responded according to the criteria of the answer. For criterion number 2, before being treated, there were 22 students who were able to answer and explain the cause but did not explain the effect, but after being treated decreased to 4 people who were able to answer and explain the cause but did not explain the effect. That was because after the treatment was given, most students who were unable to explain the effect now can explain the effect so well that they turn to criterion no 3. Based on the above analysis, the students' fluency thinking skills in experiment class for problem thinking fluency has improved.

Description of the analysis of experiment and replication can be seen in Table 4 and Table 5. Based on the results of an analysis of improved thinking of students from the experiment, replication 1, and replication 2, it can be seen that the three classes have increased in answering questions that say "explain the meaning of global warming" according to the third criterion. The table below summarizes the average value of the problem of thinking fluency with the problem of global warming, which reads explain the meaning of global warming ".

Table 6. Average score of thinking fluency questions for experiment, replication 1, and replication 2.

Class	Average score of pre-test	Average score of post-test	Increase (%)
Experiment	62.42	90.60	28.18
Replication 1	68.48	90.60	22.12
Replication 2	72.12	88.78	16.66
Average	67.67	90.00	22.32

By calculating the average value of the post-test and pre-test of the whole class, then calculate the difference between the average score of the pre-test and post-test of the three classes, the results obtained that smooth thinking skills increased by 22.32%. Through Table 6 above, it is known that the students' fluent thinking skills have improved after the guided inquiry learning process was given. In the process of guided inquiry learning students were guided by teachers to be able to understand the material of global warming through the greenhouse effect experimentation activities so that they have directly integrated their skills in the matter of global warming. It was in line with the thinking of [3] who thought that associative thinking and conceptual integration powerfully shape learners' skills. Implementation of the inquiry learning model increase of students thinking, especially in fluency thinking abilities [16, 17]. The implementation of learning through inquiry learning model is also contributes to the effort of educational reform in Indonesia, especially in learning innovation [18].

4. Conclusion

Based on the results and discussion, it was found that guided inquiry learning was carried out well. the ability to think fluency of students have increased by 22.32% which was marked when students describe ideas or ideas fluency on global warming material that was in accordance with the assessment criteria made by researchers. By applying the guided inquiry model, students can improve their ability to think fluently. It is highly recommended to the another researcher to utilise Inquiry Learning Model to increase students' fluency thinking abilities.

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