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The effectiveness of the integrated inquiry guided model STEM on students scientific literacy abilities

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Abstract

Science literacy is very important to be prepared for the younger generation in order to solve problems in life. STEM integrated guided inquiry is a strategy that can be done to improve scientific literacy in the learning process. We examine the effect of the integrated STEM guided inquiry model on students' scientific literacy abilities. A total of 66 middle school students participated in this study. Data were collected from one question instrument and then analyzed by normality test (chi square), homogeneity test for variance and hypothesis test (t-test). STEM integrated guided inquiry model has a significant effect with significance level 1% ($\alpha = 0,99$) is obtained $t_{count} 7,9 > t_{table} 2,66$. Based on the result obtained that STEM integrated guided inquiry model that can improve literacy science skills compared to conventional model

Keywords: Guided Inquiry; STEM; Science Literacy.

1. Introduction

The development of science and technology currently influences various fields of life including education. Along with these developments, human resources are of course needed. Education has an important role in preparing quality human resources. The potential that must be possessed by cultivating the skills of logical thinking, critical thinking and creative thinking towards the times.

The development of science and technology spurs every individual to have the ability of scientific literacy as a provision to deal with the times. The ability of scientific literacy is important to be

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mastered by students because it relates to how students understand the environment, health and other problems faced in social life in the modern era that are very dependent on technology and the development of science.

Based on the results of a recent pisa (program for international student assessment) study in measuring students' scientific literacy abilities stated that Indonesian students' scientific literacy abilities were classified as low with an average score of 403 and ranked 62nd out of 70 participating countries. This low scientific literacy ability is due to the fact that learning is still centered on the teacher (teacher centered) compared to students, the learning method is less related to the real problems of life between science and technology [1] [2].

The guided inquiry learning model that can improve scientific literacy has been proven in its research at SMAN 1 Kedamean on optical instrument material with the acquisition of 85% in the high category. Correspondingly, in his research confirmed that the guided inquiry model was able to increase scientific literacy in SMAN 1. Weakness in the material elasticity with the acquisition of n-gain (0.80) in the high category. Different things were proven by Suarsini, in biology students at State University of Malang in the course of plant physiology with the acquisition of a percentage of 57.37% of medium category [3].

In addition to the guided inquiry learning model, learning today needs to keep abreast of the times in the era of globalization, one of which is by integrating stem (science, technology, engineering and mathematics). The relationship between science and technology cannot be separated in the study of science. Stem is a scientific discipline that is closely related to each other. Science requires mathematics as a tool in processing data, while technology and engineering are applications of science. Stem is more appropriate when combined with learning models that can increase scientific literacy [4].

Research conducted by [5] [6], shows that the stem approach is able to increase scientific literacy and creative thinking of students through the application of stem worksheets in physics in SMP 1 Lampung with an average n-gain (0.71) in the high category. In addition, the integrated stem approach of project based learning models has been proven by Afriana, on the biology subject of environmental pollution sub-material in the integrated Islamic Middle School of Sukabumi Regency that integrated learning is able to improve scientific literacy through the application of multiple choice test questions with the average -gain (0.31) in the medium category. Then, the same thing was also proved by [7] in her research at SMPN 2 Malang on the matter of global warming showing the average n-gain results (0.58) in the medium category.

Based on the data that has been found, the study of the stem integrated inquiry learning model has not been adequately investigated in schools in Indonesia [8]. This is our main reason to do our studies in this area and try to identify the close relationships that have not been revealed. This study was designed to determine the effectiveness of the integrated inquiry guided learning model on the ability of scientific literacy on aspects of knowledge possessed by students in biology subjects [9]. The information used in this study can be used as a basis for developing students' scientific literacy abilities through the integrated stem guided inquiry learning model in class X students on environmental change material [10] [11] [12].

2. Materials and methods

2.1. Research scope

This research was conducted at the 98th High School in Jakarta in the even semester of the 2018/2019 school year from March to July. Samples were taken randomly (random sampling), namely Class X MIPA 1 as an experimental class with 33 students, and Class X MIPA 2 as a control class of 33

people. This research used a multiple choice test instrument that contained 3 indicators of knowledge aspects of scientific literacy, namely content, procedural and epistemic aspects of knowledge.

2.2. Research design

The research method used is Quasi Experiment. Researchers use this method because the control group that is owned cannot function fully to control the variables from outside that affect the implementation of the experiment while the type of research used in this study is quantitative. The sampling technique is done randomly. Data collection uses research instruments to analyze data using statistics that aim to test a hypothesis.

2.3. Research procedure

There are several stages of research carried out, namely the initial stage (preparation), the core stage, and the final stage (data processing). The preparation phase includes a literature study that is gathering information about the science process skills, an integrated STEM guided inquiry learning model [13], preparing a research instrument, conducting an instrument judgment to the supervisor I and the supervisor II. After that, a revision was made based on the results of the judgment which was then tested on the students of class XI MIPA 1 followed by the test validity and the reliability test. The implementation phase in class X MIPA 1 as an experimental class is used STEM integrated guided inquiry learning model which includes 7 stages namely, problem orientation (science), formulating problems (science and engineering), collecting data (engineering), making hypotheses (science and engineering), conducting experiments (science, technology, engineering), analyzing data (engineering and mathematics) and drawing conclusions (science and engineering). Learning as much as 4 meetings. At each stage of the integrated inquiry inquiry model STEM the teacher applies the ability of scientific literacy to train students. The material used in learning is Environmental Change material. At each integrated guided inquiry learning stage STEM the teacher raises indicators of knowledge aspects of scientific literacy, at the end of the meeting the teacher gives written choice questions in the form of multiple choice. After carrying out the implementation phase and getting the results of the implementation, then analyzing the data by conducting prerequisite tests first, namely the normality test and homogeneity test after both normal and homogeneous data, then the t-test (hypothesis test) is performed.

2.4. Data collection and data analysis

Data collection in the form of multiple choice test questions as many as 25 items that have been through the process of validation and reliability. Data analysis was performed with Microsoft Excel software. After that the data analysis is done with the normality test to find out whether the sample comes from populations that are normally distributed or not. Analysis of normality test using Microsoft Excel software. The criterion for this normality test is to accept H_0 if χ^2 count $<$ χ^2 tables at the 0.01 level.

After analyzing the normality test, a two variance homogeneity test is performed, using the Fisher test formula using the formula.

$$F = \frac{\text{Large Variant}}{\text{Small Variance}}$$

Furthermore, the data analysis was continued using hypothesis testing with a level of 0.99. The following is the formula used for t test data analysis [14].

$$t = \frac{X_1 - X_2}{\sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2} \left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2} \right)}}$$

3. Results and discussion

The use of the integrated inquiry learning model stem on students' scientific literacy abilities was carried out on may 1 to may 30, 2019. A total of 66 students from 2 classes were involved in this study. The results of this study are the data obtained that the ability of scientific literacy through research instrument is in the form of multiple choice test questions as many as 25 items. In this research the types of scientific literacy capabilities in the aspects of knowledge measured include, content knowledge, procedural knowledge and epistemic knowledge. The posttest results showed that the ability of students' scientific literacy after being applied with the stem integrated guided inquiry learning model increased student learning processes, especially in the experimental group treated with the integrated stem guided inquiry model. The results of the experimental and control class posttest can be seen in figure 1.

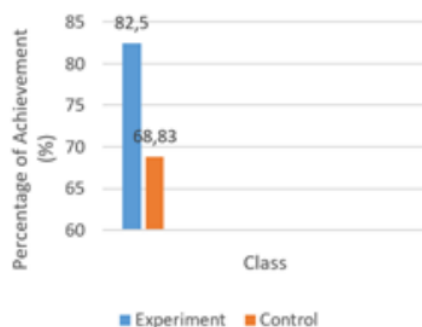


Figure 1: The posttest results of students' scientific literacy abilities in the experimental class and the control class

The posttest results of the experimental class showed the highest mean (82.5). This shows that the scientific literacy ability of the experimental class is better when compared to the control class. The ability of scientific literacy aspects of epistemic knowledge in the experimental class is greater than that of the control class according to the data on each indicator of scientific literacy knowledge in

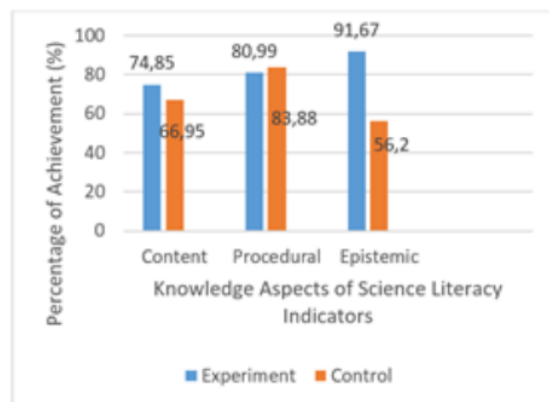


Figure 2: Comparison of students' abilities in each indicator in the experimental class and the control class.

The STEM integrated ² guided inquiry learning model can influence students' scientific literacy ability in the aspect of knowledge because it has 7 stages that play a role in developing scientific literacy abilities, namely the problem orientation stage, formulating problems, collecting data, making hypotheses, conducting experiments, analyzing data and drawing conclusions ¹⁵. The results of this study are supported by research conducted by ¹⁶ which states that guided inquiry learning can improve scientific literacy because guided inquiry learning links material taught with life around it with guidance and direction from the teacher so students can formulate, collect, analyze and draw conclusions from the problems discussed. Percentage value of the three indicators is different, the biggest value shows the indicator of epistemic knowledge, because the integrated inquiry inquiry model STEM has a stage of concept comprehension, this is because during the learning activities, students actively ask the teacher or other students, at certain times The teacher gives questions to students to hone students' knowledge. This is done to arouse students' interest in learning by linking environmental change material to everyday life.

The percentage of the average value of the content knowledge indicator in the experimental class obtained 74.85% has a difference with the control class that gets a result of 66.95% difference between the two that is 7.9%. The high gain in the experimental class is due to the STEM integrated guided inquiry learning at the assessment stage students are trained to infer the learning outcomes that have been carried out that day. At the first meeting, students are given worksheets containing environmental damage that has recently occurred as a result of environmental pollution. At the second meeting, students conducted an experiment with a simple water purification effort and a worksheet. Then students are trained to be able to conduct trials, analyze data to draw conclusions well.

The average value of procedural knowledge indicators ⁹ in the control class was 80.99% higher than the experimental class with an average value of 83.88%. This is because in the learning process in the control class some students are active in asking questions and have a good curiosity so that in this procedural knowledge the highest average in the control class is obtained.

The percentage of epistemic knowledge indicators in the experimental class was 91.67% higher than the control class with an average value of 56.2%. The ability of scientific literacy on aspects of epistemic knowledge is the first highest value. This is due to the initial phase of the first meeting and subsequently students are given a video in the form of problems that often occur in the surrounding environment due to environmental pollution that results in environmental change ²³.

Overall indicators of achieving scientific literacy skills on aspects of knowledge in the experimental class showed better results compared to the control class. It is evident from the results of research that has been done that the integrated inquiry inquiry learning model STEM can help students in developing scientific literacy skills in biology subjects, especially the subject of Environmental Change. The results of this study are in line with research conducted by ¹⁷ which states guided inquiry learning can improve students' scientific literacy skills. ¹⁸ explain that guided inquiry learning can improve the ability to understand concepts and scientific literacy. ¹⁹ explain that guided inquiry learning can improve students' social attitudes and knowledge. The role of STEM science learning is integrated into learning plans and instruments for achieving scientific literacy in line with research conducted by ²⁰.

¹³ 4. Conclusion

Based on the results of the study, it can be seen that the ability of scientific literacy in aspects of student knowledge after being given normal distribution treatment. T test results show that there is an increase, this shows that the stem integrated guided inquiry learning model on the subject of

environmental change affects the ability of scientific literacy. Student learning activities using the integrated inquiry inquiry learning model stem make students have the ability in scientific literacy. So students can improve their scientific literacy skills well.

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