

The Effectiveness of 7E Learning Model to Improve Scientific Literacy

Fitri Mur Fatimah
Universitas Negeri Surabaya
Surabaya, Indonesia
fitrimur@gmail.com

Nur Fitria Anggrisia
Universitas Negeri Surabaya
Surabaya, Indonesia
ria.anggrisia@gmail.com

Abstract—Scientific literacy is one of the competencies that students must possess to face challenges in the 21st century. Scientific literacy is a skill to understand the surrounding natural and social phenomena and be able to make scientifically correct decisions to live more comfortable and better. Students who have scientific literacy skills are expected to be able to think critically, solve problems creatively, collaborate with others, and communicate better. The aim of this study is to show that the 7E learning model can improve the scientific literacy of elementary students. The research method used in this study is a quasi - experiment, one group pre-test post-test. The results of the pre-test and post-test showed a significant increase. These results indicate that the 7E learning model can improve the scientific literacy of elementary students.

Keywords—7E learning model, scientific literacy

I. INTRODUCTION

The 21st century is a century of knowledge, a century in which information widely spread and technology is growing. 21st-century education is education that focuses on efforts to produce young people who have four main competencies, namely the competence to think, work, live, and master the tools to work. Concerning thinking competency, 21st-century education is directed to form graduates who can solve problems, think metacognition, and think creatively. They are expected to be able to master 21st-century skills, one of which is science literacy, which is very important in our modern society because of many issues related to science and technology. Science literacy is the ability to understand the natural and social phenomena around us. The ability to make the right decisions scientifically so that we can live more comfortably, healthier, and better. Science literacy is a necessity for everyone and becomes very important for someone because the progress of a nation's retreat is determined by the quality of human power that has literacy in science and technology [1].

The results of the 2015 PISA Study show the level of scientific literacy of Indonesian students, which is not much different from the results of the previous year's study. The level of scientific literacy of Indonesian student ranks 62nd out of 69 countries with a score of 403, and this score is below the standard average of PISA. The 2015 PISA standard is 493 [12]. Preliminary data collection in schools showed that the science learning tool in the school did not contain aspects of scientific literacy and the results of pre-study showed that only 43% of students who completed the scientific literacy test with scientific literacy levels were still at level 3. Meanwhile, nowadays students are expected to be

able to use knowledge content, procedural knowledge, and epistemic knowledge to provide explanations on higher cognitive levels. There is a problem with the condition of learning activities at school, so the application of innovative learning models is needed so that it can improve scientific literacy skills of sixth-grade elementary students.

Learning Cycle 7E model is a learner-centered model. This model consists of stages of activities organized in such a way that students can master the competencies that must be achieved in learning by playing an active role. These stages are elicited, engage, explore, explain, elaborate, evaluate, and extend [7]. Learning Cycle 7E models have several advantages, including: stimulating students to remember the subject matter they have learned before, motivating students to be more effective and increasing students' curiosity, training students to learn to do concepts through experimental activities, train students to convey verbally the concepts they have learned, provide opportunities for students to think, search, find, and explain examples of the application of the concepts they have learned. Learning Cycle 7E model with seven learning steps is expected to be able to improve the scientific literacy component that has been established by PISA, namely: knowing scientific questions can be improved at the elicit and engage stages, identifying the evidence needed in scientific investigation can be improved in the explore, draw and evaluate conclusions, and communicating valid conclusions can be increased at the explain stage, assessing the accuracy of the answers can be improved in the evaluation stage, and demonstrating an understanding of scientific concepts can be improved in the elaborate and extend stages.

Previous research shows the effectiveness of a learning model, namely the 7E learning cycle model is very effective applied to pure science. Research conducted show that the application of the 7E Learning Cycle model can improve student learning outcomes and generic science skills [2]. Qulud show that there is a significant increase in scientific literacy skills between experimental classes than control classes [11]. Similar research was also carried out [5] which showed that there were significant differences between the experimental group students and the 7E model more successful than the control group, in addition, the 7E model gave a positive impression to participants educated in the experimental group to reduce misconceptions and prove that the 7E model is effective learning. Learning Cycle 7E learning models suggest that the learning process can involve students in active learning activities so that the process of assimilation, accommodation, and organization in the cognitive structure of students is achieved. If there is a good

knowledge construction process, students will be able to increase their understanding of the material being studied.

Concerning with the problems in scientific literacy, the researchers conducted research entitled “The Effectiveness of 7E Learning Model to Improve Scientific Literacy”. The aim of this study is to investigate how the effectiveness of the science learning device which oriented to the learning cycle 7E model to improve scientific literacy skills of sixth-grade elementary students. The results of this study are expected to be used as a reference in teaching and learning activities, in preparing the planning and implementation of learning using the 7E learning cycle model to improve the scientific literacy of sixth-grade elementary school students.

II. RESEARCH METHOD

A. Research Design

The design of this study used a pre-experimental One Group Pre-test and Post-test Design. Observations did before the experiment (O1) are called pre-tests, and post-experimental observations (O2) are called post-tests [4]. This study does not use a comparison class, but has used the initial scientific literacy test accurately. In this study, the subjects of the study were first given a pretest test to find out which students' initial abilities before being given science learning based on the 7E learning cycle model. After being given a preliminary test, students were then given learning using the 7E learning cycle model. After it finishes 7E learning cycle based science learning for all students given the final test (posttest) to determine students' scientific literacy abilities. This study used the following research design:

O1 X O2

Where:

O1: Pre Test

O2: Post Test

X: treatment with the 7E learning cycle model.

B. Data Collection

Data collection techniques used in this study were observed, scientific literacy tests, and questionnaires. The observation technique aims to obtain data during the implementation, obstacles encountered during implementation, and students' attitudes using the 7E learning cycle model. The test in this study is a scientific literacy test. Scientific literacy tests are used to measure scientific literacy skills in students. The questionnaire aims to determine students' responses to the implementation of learning activities. This questionnaire is used after learning and answered by students.

III. DATA ANALYSIS

A. Completeness of Learning Outcomes

1) Individual completeness

The individual completeness of a learner can be said to be complete if the percentage of indicators is by the score of completeness minimum criteria KKM of Muhammadiyah 2 elementary schools in Sidoarjo which is 75% of students in one class get a value of ≤ 72 .

2) Classical completeness

Completeness of the (classical) class is said to be competent if the total number of students who are complete learn 85% of the total number of students.

B. Analysis of Students' Science Literacy Ability

1) Sensitivity Analysis of the Problem Item

This test is used to determine the effectiveness of the question. Questions are said to be effective if answered correctly by more students after the learning process. To calculate the sensitivity, index the influence of the teaching and learning process (S) can be calculated with statistics:

$$S = S = \frac{B_{SS} - B_{SB}}{T} \quad [8]$$

Information:

BSs: the total number of students who answered correctly after the learning process took place

BSB: the total number of students who answered correctly before the learning process took place

Q: Number of students

The price of the maximum sensitivity index is 1.00 while the minimum index is zero. A large price indicates a high level of sensitivity and shows a level of sensitivity to the effects of teaching, while the low sensitivity index has two possibilities, namely the first possibility is that the item is less able to measure teaching and the second possibility is that teaching is not effective. Teaching is said to be effective if the sensitivity level is between 0 to 1.00

2) Analysis of Student Science Literacy Competency Domains

Analysis of the domain of scientific competencies of students is obtained from the observation of the assessment of the domain of scientific literacy competencies of students.

3) Analysis of Knowledge Science Literacy for Students

From the data of the pretest and posttest results obtained by students then analyzed using N-Gain to determine the increase in learning of scientific literacy of students after using learning tools with the 7E Learning Cycle model [6].

$$N\text{-Gain} = \frac{S_{\text{post}} - S_{\text{pre}}}{S_{\text{max}} - S_{\text{pre}}}$$

Information:

S_{post} = Posttest score

S_{pre} = Pretest score

S_{max} = Maximum score

Furthermore, from the results of the N-Gain calculation, it is then converted to the criteria in table 1.

TABLE I. N-GAIN CRITERIA

Score $N\text{-Gain}$	Normalized Gain
$0,70 < N - \text{Gain}$	High
$0,30 \leq N - \text{Gain} \leq 0,70$	Medium
$N - \text{Gain} < 0,30$	Low

4) Analysis of Attitude Domain of Science Literacy of Students

Analysis of the domain of scientific literacy competencies of students is obtained from the observation of the assessment of the area of scientific literacy competencies of students.

IV. FINDINGS AND DISCUSSION

A. Completeness of Individuals and Classics

Individual completeness is analyzed from the results of the pre-test and post-test using a comparison of the results obtained by students. The criteria for completeness are 72 according to the score standard set by the school. The results of the analysis of individual completeness can be seen in Figure 1.

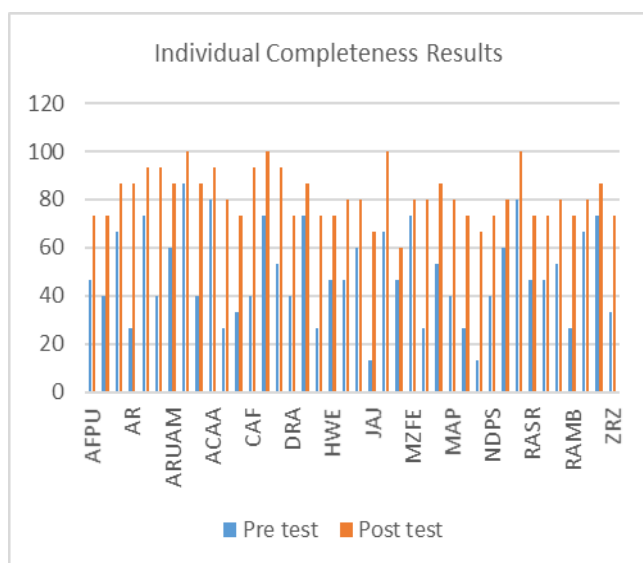


Figure 1 Individual and classical completeness results

Based on Figure 1, it is known that the average completeness of the individual pre-test scores is 48, while the average post-test score of individual completeness is 77. The classical completeness of science learning through the 7E learning cycle model by 40 children at pretest is 7%, and classical completeness at post-test is 87%. This proves that learning completeness has a significant increase and completeness in classical >85% of the total number of students, so it can be said that the classical completeness of learning with the 7E learning cycle model has been achieved.

2. Science Literacy Students

a) Sensitivity Analysis of the Problem Item

The sensitivity of a question item is a measure of how well a problem distinguishes between students who have received learning with students who have not received learning. Sensitivity analysis of items can be seen in Figure 2.

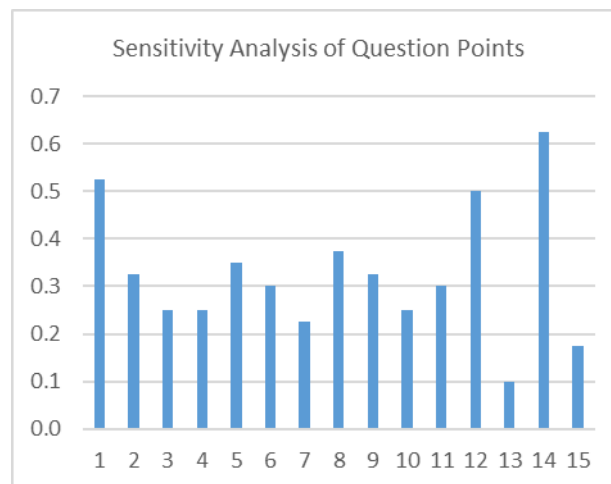


Figure 2. Sensitivity Analysis of Question Points

The results of the calculation of the completeness of scientific literacy indicators can be seen in Figure 3.

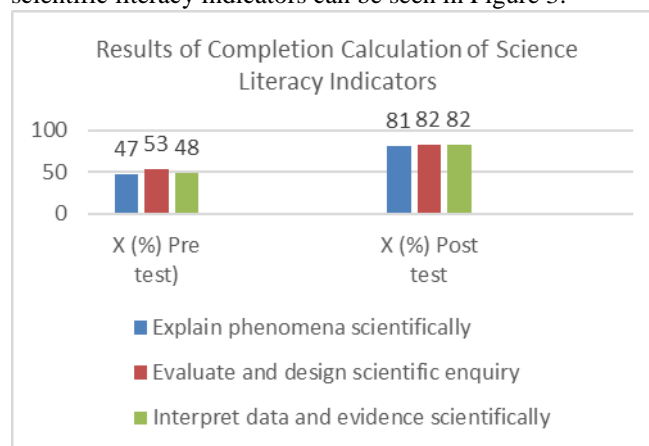


Figure 3 Results of completion calculation of science literacy indicators

b) Student Science Literacy Analysis

Scientific literacy analysis can be seen from the three domains of scientific literacy, which include domains of competence, knowledge, and attitude. Aspects of scientific literacy competency include presenting data and information, expressing problem-solving ideas, and presenting the results of group discussions. These three aspects are obtained from the results of assessment observations while learning is ongoing. Aspects of scientific literacy knowledge of students can be seen from the results of students' literacy learning can be obtained by comparing the results of the pre-test and post-test students using normalized gain (N-Gain). Aspects of scientific literacy attitudes include spiritual attitudes and social attitudes. Spiritual attitude (religiosity) involves praying before starting or completing activities, greeting, and giving thanks for the results achieved. Social attitudes include cooperating, actively asking questions, and actively expressing opinions. These aspects are obtained from the results of assessment observations while learning is ongoing.

In general, scientific literacy skills of students can be seen in Figure 4.

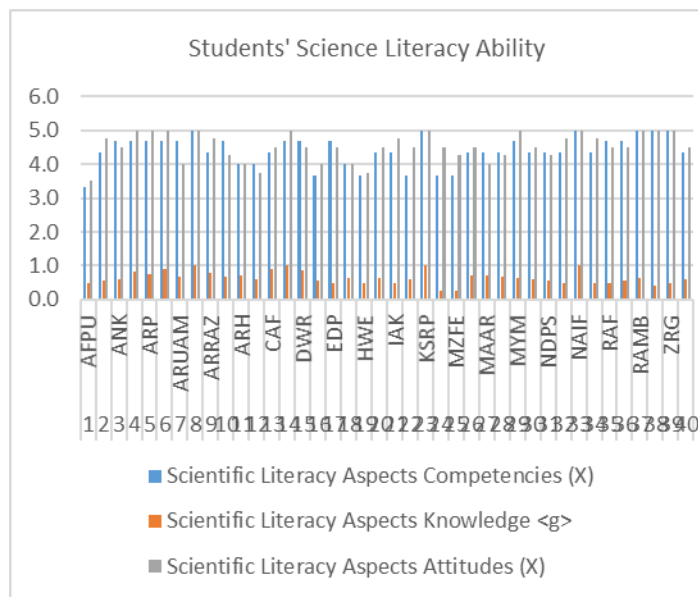


Figure 4 Students' Science Literacy Ability

The science competency domain refers to the mental processes involved when answering a question or solving a problem [13]. Competency aspects involve cognitive processes and scientific inquiry processes. The cognitive processes involved in scientific competence include inductive or deductive reasoning, critical and integrated thinking, and constructing explanations based on data. Based on observations, the average scientific literacy competency in the category is very good with an average of 4.4. Competency assessment that includes cognitive processes and scientific inquiry includes presenting information, data, expressing ideas, and presenting the results of the discussion. The involvement of students to achieve scientific literacy competencies is closely related to learning oriented to the 7E Learning Cycle model. Learning with the 7E learning cycle model expects students to be more active and critical both in understanding the concept and addressing a problem. Mariana and Praginda (2009: 30) state that someone who studies science must understand the concept, apply, and be responsive to natural phenomena around [9]. This opinion was reinforced by Toharudin who stated that the scope of scientific aspects of the process of literacy, the ability of students is used to find and interpret and search for evidence.

In the aspect of science knowledge, students need to capture some important concepts to understand certain natural phenomena and changes that occur due to human activities [12]. The N-Gain results show that students who experience increased scientific literacy skills after learning through the 7E learning cycle model and classified as high categories. The acquisition of N-gain shows that the learning tools developed by the 7E learning cycle model are quite effective in training students' literacy skills.

Assessment of scientific literacy attitudes is an assessment of interest in science that supports scientific findings with selected indicators consisting of aspects of spiritual attitude (religiosity) and social aspects which

consist of working together, actively asking questions and expressing opinions, and being responsible. Observations were made during the learning process, from working on the LKPD to presenting the results of the investigation. The results of attitude domain assessment showed that students showed excellent scientific literacy attitudes with an average of 4.5. Based on this, students are expected to be able to conclude the role of science to choose and integrate information from various disciplines directly into aspects of life situations, reflecting actions and can communicate using science, decisions, and facts.

c) Student Response

The results of student responses to learning can be seen in Figure 5.

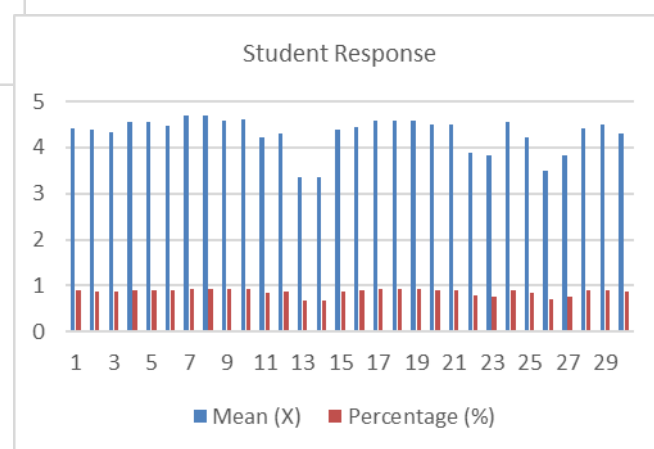


Figure 5. Student Response

The results of the student response analysis show that the response of students responds more positively to the novelty of the learning component with an average percentage of 94%. The learning, novelty component consists of student textbook format, student activity sheet, investigation, teaching-learning atmosphere and the way the teacher teaches with the 7E learning cycle syntax. Students feel very excited about the experiment they have done in the science laboratory. Besides, they also enthusiast with the format of student activity sheets that have hypotheses, problem formulation, manipulation, control, and response variables. They also feel new with the learning atmosphere in the science laboratory and the way teachers are teaching more active and fun.

Students feel happy and interested in learning by using the tools resulting from the development of the 7E learning cycle to improve scientific literacy. It correlates with the principles of Piaget's theory in learning activities about the involvement of students actively during the learning process [3]. Learning activities should be able to attract interest and improve students' understanding for students to be active in the learning process, teachers need to link new knowledge with the cognitive structure that students already have, as well as subject matter needs to be prepared using specific patterns, from simple material to complex ones.

V. CONCLUSION

Based on the result of the research and discussion above, it can be concluded that: (1) The average results of competency domains are 4.4 with very good categories; (2) The average result of attitude domain is 4.5 with very good categories; (3) The measurement results of the knowledge domain calculated by N-Gain indicate the medium and high categories; (4) students' responses to lessons by 87% of students respond positively to the 7E learning cycle model. This shows that learning with the 7E learning cycle can effectively improve students' literacy skills.

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