



The Student Health Literacy Using Teaching Materials in Science, Technology, Engineering, Art, and Mathematics (STEAM)

Endang Widi Winarni^(✉) and Irwan Koto

Postgraduate of Elementary School Teacher Education, Faculty of Education and Teacher Training, University of Bengkulu, Bengkulu, Indonesia
endangwidi@unib.ac.id

Abstract. The study aims to describe learning activities and health literacy for students using science teaching materials with STEAM. Classroom Action Research was carried out in three cycles for Master Program in Elementary School Teacher Education students, Faculty of Education and Teacher Training, University of Bengkulu in the first semester 2021/2022. The lecturer with observation sheet instruments collected the learning activity. Test instruments used to measure health literacy aspects of content, attitude, context, and performance reports for competency aspects. The success indicators include (1) lecturers and students' activities in the learning process using STEAM materials that shown a good category; (2) the students' percentage shown at least 80% in the good category for the health literacy aspects of content, context, competence, and attitudes. Based on the actions, It can be concluded that (1) lectures used STEAM IPA teaching materials could increase student activity into an excellent category in the third cycle; (2) The students' percentage who achieved good health literacy for content aspects in the first cycle was 58.33%, the second cycle reached 75%, and the third cycle reached 83.33%; (3) the context in the first cycle by 62.5%, the second cycle it reached 83.33%, and the third cycle reached 91.67%; (4) the attitude aspects in the first cycle was 70.8%, the second cycle reached 79.16%, and the third cycle reached 83.33%; and (5) the competency aspects in the first cycle is 75%, in the second cycle it reaches 83.33%, and the third cycle reaches 91.67%.

Keywords: Science · Teaching Materials · STEAM · Health Literacy

1 Introduction

Science learning is learning that directed with the real world as a context for student life. Learning science is inseparable from critical problem-solving skills from identifying problems and finding ways to solve them. Students solved the issues in science by making discoveries that were taken through activities: observing, reading, conducting experiments, discussion with experts, and seeing pictures [1]. The activities were presented in a science teaching material directed in the real world to acquire essential knowledge and concepts. The process and learning outcomes are expected to increase

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the science and technology awareness to meet the scientific literacy skills. Scientific literacy must be mastered by all parties, from teachers, students, and other stakeholders related to science education.

Scientific literacy is urgent to be mastered by students related to the environment, health, economy, and other problems [2, 3]. The main elements in scientific literacy include knowledge of content, processes, scientific attitudes, and science application in life. Learning science emphasizes memorizing and is also process-oriented and the achievement of scientific attitudes and competencies.

In science learning, the sources of scientific literacy are obtained by students teaching materials. It facilitates student literacy development by integrating elements of Science, Technology, Engineering, Art, and Mathematics (STEAM) [4]. STEAM teaching materials improve students to (1) find problems and solve the problems with innovation and creation, (2) explore by combining STEAM in the learning process [5].

The research contribution is the use of STEAM in science teaching materials used in Science Basic Concepts lectures to improve health literacy, including aspects of content, context, attitudes, and competencies in students. Furthermore, the research provides suggestions: 1) for lecturers as course supervisors and researchers to improve the quality of innovative, interactive teaching and learning materials. 2) for master's students in Elementary School Teacher Education give the insight to use STEAM as science teaching materials and improve health literacy.

2 Method

This research used classroom action research in three cycles. In the first cycle, starting from the initial identification as an initial reflection, the researchers conducted: (1) discussions with the lecturer's team, analyzed learning outcome and the scope of lecture material, and (2) measured students' initial abilities. Each cycle consists of planning, implementation, observation, and reflection [1]. Cycle I researched the topic of human circulatory system. Then, cycle II analyzed the digestive system in humans. Last, cycle III discussed the respiratory system in humans. This research was carried out in the Master Program in Elementary School Teacher Education students, Faculty of Teacher Training and Education, University of Bengkulu in the first semester of 2021/2022 totaled 24 people.

Instruments were used for collecting observational data and tests. Also, rubrics were used for assessing performance reports. Observations on student activities in learning focused on using teaching materials as learning resources that integrated with STEAM. Science activity provided information: (1) essential competencies, indicators, and objectives, (2) concept maps, (3) material in the form of text, images, questions/problems. It arranged for students to solve the daily life problems. Technology provided the video in barcode link for students' collaboration in-process and conveyed the information. Engineering presents problems and ways of working. It is intended for students to create a product and find the right solutions. In the field of art, it showed pictures and videos to clarify concepts that improve students' ability to develop products or promote findings. Mathematics presents data to support science presentations. Students use a mathematical approach to process the data.

Another instrument was a written test to measure health literacy in content, context, and attitude. Content aspect measures students' ability to explain the main facts, concepts, and explanatory theories based on scientific knowledge. Next, the context aspect measures students' ability to relate personal, local/national, and global issues involving science and technology. Attitude aspects measure students in science response, scientific assessment, awareness, and concern with environmental problems. For health literacy, the competency aspect measured by a performance report with digital posters about health care includes clarity, content truth, daily life problem, and attractiveness.

Data analysis techniques used: (1) the observation data from learning activities, namely students focused on STEAM teaching materials in a scale from 1-less, 2-enough, 3-good, and 4-excellent; (2) the test data of content, context, and attitude aspects analyzed in a score from 10 to 100; and (3) the data on the science competency aspects used a performance report assessment sheet with a score from 10 to 100. The successful of action, an indicator such as (1) the activities of lecturers and students to carry out lectures using STEAM in teaching materials reached the good category; (2) the percentage of students who show attitudes, context, knowledge, and science competence in good category reached a minimum of 80%.

3 Results

3.1 Learning Activities

Learning activities following the STEAM presentation observed students' fluency in using teaching materials that contain all STEAM variables. Student activities in the first cycle showed fluency or good category in using science and technology information. Scientific information in teaching materials is presented in pictures and text about the human circulatory system. In the technology, learning videos are presented in the form of barcode links. Students have demonstrated the ability to connect the initial concepts with the concepts presented in the STEAM science teaching materials about the human circulatory system. Moreover, the ability related with the heart, blood, blood vessels, large and small circulatory systems, and the disturbances for problems identification.

Three variables, engineering, art, and mathematics, were in enough category. For engineering, students present answers to problems in the human circulatory system with poster designs that interpret the relationship between concepts. In the field of art, students have not presented posters based on science, technology, and engineering to their friends in the group. In mathematics, students have not communicated their thoughts which is reinforced by the results of data analysis using mathematical solutions.

Improvement efforts in the second cycle to strengthen the engineering field, the learning process begins with creating poster designs. Students are asked to explain the concepts used in persuasive sentences about health care. Students were directed to make posters equipped with attractive and proportional pictures about the digestive organs in the art variable. In mathematics, students determine the relationship between concepts based on the data processing or mathematical solutions as the contents of health care posters.

The learning activities in the second cycle showed that three fields, namely science, technology, and engineering, had reached the excellent category. Its two areas, namely art

and mathematics, are in the good category. In science, students demonstrated the ability to connect their initial concepts with the STEAM concepts in the teaching science course about the food digestive system. In the field of technology, students identified problems related to organs, tracts, digestive disorders, and healthy food. In the engineering field, students made poster designs and explained the concepts with persuasive sentences about health care. Next, in art, students produce a comprehensive digital health care poster for their friends in a group. Then, in mathematics, students have not communicated their thoughts based on the results of mathematical processing and do not solve the digestive system problems. The improvement efforts for the third cycle: (1) in art, students directed to make attractive and proportional posters equipped with pictures of the respiratory organs, (2) in mathematics, students communicate the results of data processing as a basis for instilling care for the health of respiratory system.

Learning activities in Cycle III show that the four fields of science, technology, engineering, and art are in the excellent category. Otherhand, it was in good category for mathematics. Comprehensively, students demonstrated the ability to: (1) relate the initial concepts with the concepts presented in STEAM about the human respiratory system, (2) identify problems related to organs, channels, and respiratory disorders, (3) make a poster design that contains persuasive sentences about the health of respiratory system, (4) produce a comprehensive digital health care poster, (5) make a poster design and ask students to explain the concepts in persuasive sentences about health care, for example, the case of Covid-19. The five STEAM areas showed a process impacting the student activities to reach good and excellent categories. Then, the action cycle was stopped.

3.2 Health Literacy

Assessment of health literacy aspects of content, context, attitudes, and competencies measured after the learning process takes place in each cycle. The results of health literacy assessment cycles I, II, and III were presented in Table 1.

Table 1 shows that the context and competency aspects for health literacy reached a good category with 83.33% in the second cycle. In the third cycle, the four aspects of health literacy have exceeded the criteria set out in this study, which is at least 80%.

Table 1. The health literacy assessment

Health literacy aspects	The assessment of each cycle		
	I (%)	II (%)	III (%)
Content	58,33	75	83,33
Context	62,5	83,33	91,67
Attitude	70,8	79,16	83,33
Competency	75	83,33	91,67

4 Discussions

4.1 Health Literacy

The observations show that student activities with good categories have increased from cycle I to cycle III. STEAM is an integration of five disciplines developed after Engineering Science Technology and Mathematics (STEM). STEM students were given knowledge, skills, and tools to improve the quality of human life in each community [6]. The use of STEM teaching materials improved electrical science learning outcomes for elementary students [7]. The integration of STEM, in science will be more meaningful with the link between science and technology, environment, society, and all of its aspects [8]. Technology refers to innovations by humans as tools in modifying nature to meet human needs and desires. It made human life better and more developed. Engineering was the study of knowledge and skills to acquire and apply knowledge. Mathematics is a science that deals with patterns, relationships and provides a language for technology, science, and engineering.

This study uses STEAM in science teaching classes. Student activity in learning using STEAM was reached a good and excellent category. STEAM integrated learning in science learning helps students improve problem-solving skills [9]. Moreover, science learning carried out by following the stages of project-based learning combined with STEAM elements develops students' ability to think critically and solve problems from daily life problems [10].

The use of STEAM increased the student learning activities. Project-based learning materials integrated with STEM/STEAM provide active and exciting learning activities, help students understand teaching materials, form-critical and creative thinking skills to solve real-world problems [10]. Students' direct experience was developed by presenting appropriate and relevant learning materials integrated with the STEAM project-based learning model. STEAM is one of the components that support the formation of scientific literacy skills.

4.2 Health Literacy

Science is a branch of science that studies all natural phenomena in the form of facts, concepts, and principles which are proven through scientific processes. Science is a collection of knowledge obtained by observations of natural phenomena, then systematically arranged to solve problems in daily life [11]. It is better to involve students in various domains in science learning, namely knowledge, attitudes, context, and multiple competencies, to find knowledge used in problem-solving in their environment.

The study results in STEAM science textbooks from cycle I to cycle III activities showed increased student health literacy aspects of content, context, attitudes, and competencies. Students' scientific literacy includes attitudes, processes, competencies/skills, and knowledge about disaster preparedness after participating in mobile learning applications [2]. The OECD explains the science framework in PISA 2015, namely issues at the personal, local/national, and global levels that involve science and technology [12]. Therefore, the existence of teaching materials that integrate STEAM elements is relevant. The science framework in PISA 2015 is that knowledge consists of content about

science. This knowledge includes understanding of nature and technology, producing the ideas, and understanding the reasons to use these procedures.

The study indicates improvement in the content aspect of health literacy. These findings were in line with the Program for International Student Assessment (PISA) statement that scientific literacy is multidimensional. Not only understanding scientific knowledge but also PISA assesses students' understanding in science characteristics such as scientific inquiry, science awareness, technology shape the material, intellectual and cultural environment, engage with science-related issues, as reflective human beings.

The improvement of health literacy was related to the context aspect with the personal context. It recognizes the need for reasoning skills in social contexts, emphasizing that scientific literacy is intended for everyone. Aspects of scientific literacy must be developed in scientific knowledge, investigation of the nature of science. Science was a way of thinking and the interaction between science, technology, and society. The context aspect is used in meeting the demands of competence over time. The STEAM learning process applied concepts in science into the real world so that students obtain innovative findings both individually and in groups.

The STEAM results in teaching materials showed an increase in aspects of student science competence. Based on data analysis from the assessment results in student performance reports, make health care posters in cycle I, cycle II, and III. It showed improvement in each process. The findings of the competency aspect of health literacy research were in line with the OECD [12], which explains that the scientific framework in the PISA competency area includes (1) explaining phenomena scientifically; (2) designing and evaluating scientific research; and (3) interpreting data and facts scientifically. This competency also includes students' abilities in collaborating, communicating, thinking critically, and evaluatively. STEAM learning is carried out no longer as a conventional classroom but has been converted into a production learning space where students design, experiment, and study all topics related to STEAM collaboratively. Students' ability to solve problems using innovation skills, entrepreneurship, and heuristics in the learning process.

The increase in attitude aspect of health literacy occurred because every student meeting practice scientific attitude. So, its values internalized and influenced their attitudes. OECD said attitudes were based on knowing, willing, being aware, to characterizing [12]. The science framework in PISA attitude includes responding to science, appreciating/valuing scientific approaches, awareness, and concern for health issues.

Engineering, science, technology, and mathematics can improve students' scientific literacy [13]. STEAM is one approach in the learning process that integrates science, technology, engineering, art, and mathematics. STEAM can be a breakthrough to create a science and technology-based economy. Students were taught comprehensively with problem solving patterns based on five aspects through STEAM [14]. The purpose of learning is to solve problems in the world based on materials and five STEAM variables. STEAM offers the possibility of activities involving students in design and engineering tasks to explore science and mathematics through creativity, expression, and visual aspects that support logical and mathematical thinking [15].

The relationship between literacy is that someone who has scientific literacy is willing to discuss science and technology discourse [16]. It requires competence to (1) explain

scientific phenomena: acknowledge, offer, and evaluate explanations for various natural phenomena and technology; (2) evaluating and designing scientific research: describing and evaluating scientific investigations, and proposing ways of dealing with scientific questions; and (3) interpreting scientific data and evidence: analyzing and evaluating data, claims, and arguments in various representations and drawing appropriate scientific conclusions.

5 Conclusion

Based on the results of classroom action research, the use of STEAM teaching materials based on problem-solving to improve health literacy for Master Program in Elementary School Teacher Education students, Faculty of Teacher Training and Education, University of Bengkulu in the first semester 2021/2022.

Using STEAM IPA teaching materials, lectures can increase student activity into an excellent category in the third cycle. The percentage of students who achieved health literacy in the good category in aspects: (1) content in the first cycle was 58.33%, in the second cycle it reached 75%, and the third cycle reached 83.33%, (2) the context in the first cycle was 62.5%, in the second cycle it reached 83.33%, and the third cycle reached 91.67%, (3) the attitude in the first cycle was 70.8%, in the second cycle it reached 79.16%, and the third cycle reached 83.33%, (4) competence in the first cycle is 75%, in the second cycle it reaches 83.33%, and the third cycle reaches 91.67%.

Based on the discussion and conclusions above, there are several suggestions to use STEAM science teaching materials. In the field of science, present: (1) basic competencies, indicators, and objectives, (2) concept maps, (3) material in the form of text, images, questions/problems. In the field of technology, present videos in barcode link to facilitate student collaboration. The engineering field presents problems and ways of working so that students design innovative products. In the field of art, present pictures and videos to clarify concepts so that students can create products or findings that are ready to be promoted. The area of mathematics presents data to support science presentations so that students can use a mathematical approach in processing the data they get. For the achievement of student literacy in the aspects of attitude, context, knowledge, and student competence to achieve the criteria for success. It is recommended to the lecturers that the substance of the assessment between literacy aspects is interrelated, and the main ideas are based on the five STEAM areas in the teaching materials used.

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