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SCIENCE LITERACY ANALYSIS OF PHYSICS INSTRUCTIONAL MATERIAL BASED ON DIGITAL TECHNOLOGY

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ABSTRACT

The development of science and technology in the era of the industrial revolution 4.0 is increasing rapidly and is a challenge for the world of education. Developing digital technology supports all current curriculum demands. However, some information obtained from the internet cannot be confirmed. For this reason, literacy skills are needed for students to be able to sort information. Indonesia's science literacy condition is currently lagging far behind compared to other countries, as can be seen through PISA. The purpose of this study was to determine the emergence of the scope of science literacy in physics instructional material for class X senior high school. This type of research used descriptive research with a qualitative approach. The research method is the document analysis method. The research population is all instructional material used by class X high school students in the city of Padang. The research samples are three instructional material used by high school class X students in Padang City. In this study used document analysis techniques and data analysis in the form of emergence of scientific literacy.The research results (1) science as a body of knowledge by 90.93%, 59, and 80%, (2) science as a way of investigating by 21.85%, 21.24% and 4.57%, (3) science as a way of thinking by 24.07%, 6.42% and 4.57%, and (4) the interaction of science, technology and society by 3.33%, 0.76% and 4.57%. This shows that it is necessary to develop these instructional material so that there is a science literacy component.

Keywords :*Science literacy, instructional material, digital technology*

I. INTRODUCTION

The development of science and technology in the era of the industrial revolution 4.0 which is growing rapidly has its own challenges for the world of education. Currently, almost all aspects of education use digital technology to support the learning process. Existing and growing digital technology supports all the demands of this curriculum. Currently, the internet can be accessed by anyone, including students. However, some of the information they can obtain from the internet cannot be confirmed for certain. For this reason, literacy skills are needed for students to be able to sort information .

In the world of education, one of the influential factors in the development of science and technology today is the ability to master science literacy. Science literacy views the importance of thinking and acting skills which involve mastering thinking and using scientific ways of thinking in recognizing and responding. Therefore, science literacy measurement determines the level of science literacy of students to achieve a high or good level of science literacy to improve the quality of education in Indonesia and enable it to compete with other countries. Science literacy is defined as the ability to use scientific knowledge to identify problems, draw evidence-based conclusions, understand nature and the changes made to it by human activity, and make decisions increase [1].

The condition of Indonesia's science literacy is currently very far behind compared to other countries. As a reference regarding the low literacy of Indonesian children, it can be seen from the presentation of the

results of international studies through the Results of PISA. Once every three years PISA issues its assessment results. Indonesia is still at a low level compared to other PISA participating countries. The science literacy assessment in PISA does not only measure the level of understanding of science knowledge, but also understanding of various aspects of the science process, as well as the ability to apply knowledge and science processes in real situations faced by students.

To form science literacy skills through education, a comprehensive introduction to science literacy is needed and must be fostered from an early age. The role of children as students is very important, because in the future it is these children who will carry out all aspects of life including the development of culture and science and technology. therefore deep aspects of education really need science literacy. Mastery of science literacy is expected to make it easier for students to adapt to science and technology in the future.

In balancing the rapid growth of science and technology, digital technology-based learning media is needed which is able to attract students' interest in learning besides that learning media can also be easily accessed by students anywhere. So that students can study anytime and anywhere. One form of learning media that is appropriate to use is digital technology-based instructional material.

Technological developments that are increasingly rapid and relatively easy to access allow instructional material to be designed in the form of electronic instructional material (e-instructional material) which can add multimedia facilities by integrating text, images, videos, simulations, animations, quizzes and interactive evaluations. Through e-instructional material, the learning process can involve audio-visual displays, sound, movies and navigation so students can be more interactive with programs designed [2].

Good instructional material are have integrated science literacy that is balanced in them. For this reason, in order to balance science and technology and meet the demands of education in the 2013 curriculum. Ideally, instructional material based on digital technology or instructional material that have been integrated with balanced science literacy are very important in the midst of teaching and learning activities in schools. It is not yet known whether the instructional material used in learning activities have been integrated with balanced science literacyso that it causes low science literacy at this time. The purpose of this study was to determine the emergence of the scope of science literacy in physics instructional material for class X senior high school in Padang city based on indicators science as a body of knowledge, science as a way of investigating, science as a way of thinking and the interaction of science, technology and society.

II. METHOD

In this study used the document analysis method. This document analysis method is used for research that is based on a content approach or content analysis. In carrying out this document analysis methods, researchers examine written objects such as books, journals, documents, and rules, meeting minutes, diaries and the like [3]

The population of this study were all instructional material used by class X high school students in the city of Padang. The sample used is physics instructional material as digital technology-based learning media used by high school students in class X in Padang. The author examined as many as three kinds of physics instructional material used by class X high school students in the city of Padang in learning activities. Sampling was done by multistage sampling technique. Multistage sampling refers to a sampling plan where sampling is done in stages. Multistage sampling is an extension of multiple samples [4].

The research procedure are:

1) Preparatory stage: Conducting literature studies related to science literacy and digital technology-based physics learning media that are most often used. Prepare a research design. Determine the subject and object to be used in research. Develop research proposals. Develop research tools in the form of tabular observation sheets containing indicators of science literacy components.

2) Implementation stage: Carry out a survey to find out which physics learning media based on digital technology (e-instructional material) class X are most widely used in the city of Padang and enter the results of the survey into the table. Conduct sampling to determine class X physics instructional material to be analyzed. Sampling was done by multistage sampling technique. This technique is carried out by taking samples gradually. The steps taken in sampling in research. The second determines three e-class X physics instructional material that have adapted to the 2013 curriculum and are the most widely

used in the city of Padang. Analyzing the physics instructional material for class X senior high school uses the 2013 curriculum per paragraph of each page which is analyzed in the e-instructional material presented using the science literacy component analysis sheet instrument. Matching the results of the analysis with the science literacy components on the science literacy observation sheet. Summing up the occurrence of statements of each component of science literacy in the three class X physics instructional material analyzed. Calculating the percentage of occurrence of the science literacy component in three class X physics instructional material analyzed [5]. Provide descriptive analysis based on data analysis that has been processed. Drawing conclusions on the analysis of class X physics instructional material.

III. RESULTS AND DISCUSSION

a. Reseach result on the science literacy component of instructional material X

The first result part of the research on teaching material X about the components of science literacy are based on indicators of science as a body of knowledge in chapters 4, 5 and 6. The appearance of the deep literacy component is seen in figure 1. As can be seen in Figure 1 that the emergence of literacy components in science as a body of knowledge in chapters 4,5 and 6 based on sub-indicator a which presents facts, concepts, principles and laws which contains as many as 64 statement items has a percentage of 75%, then indicator b which presents hypotheses, with statements of 4 items with p5% then indicator c with theories and models asking students to remember knowledge or information has science literacy statements of 2 items with a percentage of 20%.

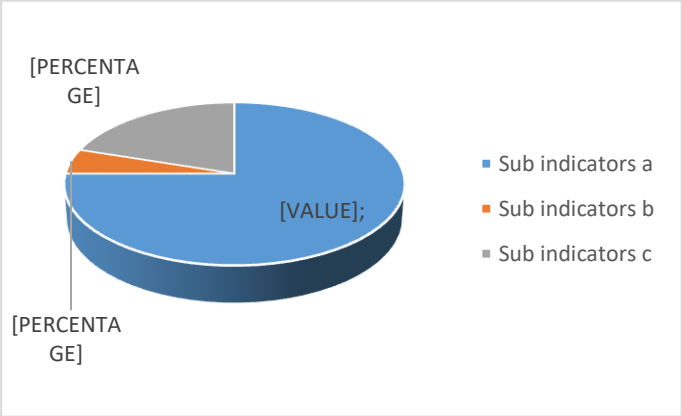

Fig. 1. The emergence of literacy components in science as a body of knowledge

The second part of the research on teaching material X about the components of science literacy is based on indicators of science as the nature of scientific investigations in chapters 4, 5 and 6.The appearance of the deep literacy component is seen in figure 2. As can be seen in Figure 2 that the emergence of literacy components in science as the investigative nature of science in chapters 4, 5 and 6 in sub-indicator a with a percentage of 65% with 5 statements, and sub-indicator B is 6% with the number of questions is 2 items, then the sub-indicator c is 26% with 8 statements, then the sub-indicator d is 6% with a total of 1 question. And the last is the sub-indicator e with a percentage of 0, which means that there is no emergence of science literacy in the sub-indicator e.

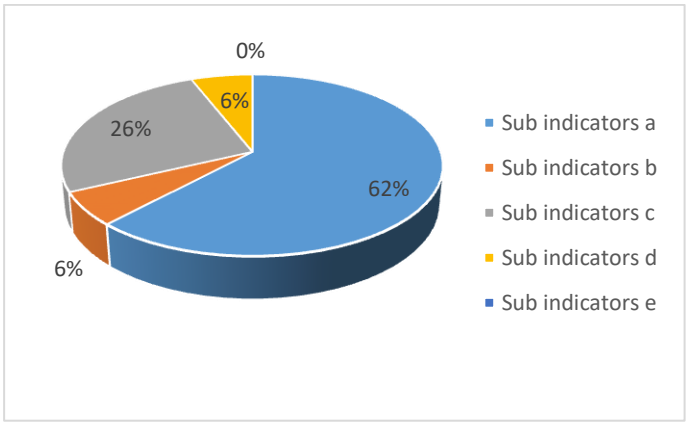

Fig. 2. The emergence of literacy components in science as the investigative nature of science.

The third part of the research on teaching material X about components of science literacy based on indicators sains as a way of thinking in chapters 4, 5 and 6. The appearance of the deep literacy component is seen in figure 3. As can be seen in Figure 3 that in chapters 4, 5 and 6 which were examined by researchers the emergence of science literacy was only in indicators d, e and f with a percentage for indicator d of 81% with a total of 5 questions, and for sub-indicator e as many as 5% with a number of statements of 1 question, and sub-indicator f of 3 questions with a percentage of 14%.

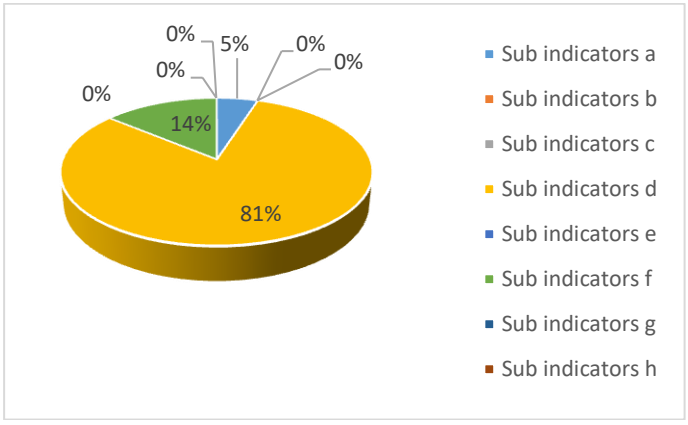

Fig. 3. The emergence of literacy components in science as a way of thinking

The fourth part of the research on teaching material X about components of science literacy based on indicators science as interaction of sciece, technology an socienty in chapters 4, 5 and 6. The appearance of the deep literacy component is seen in figure 4. As can be seen in Figure 4 that science literacy only appears in sub-indicator e of 3.33% in 3 statements, meanwhile in other sub-indicators there is no occurrence of science literacy, therefore the emergence of science literacy in indicator e is considered 100%.

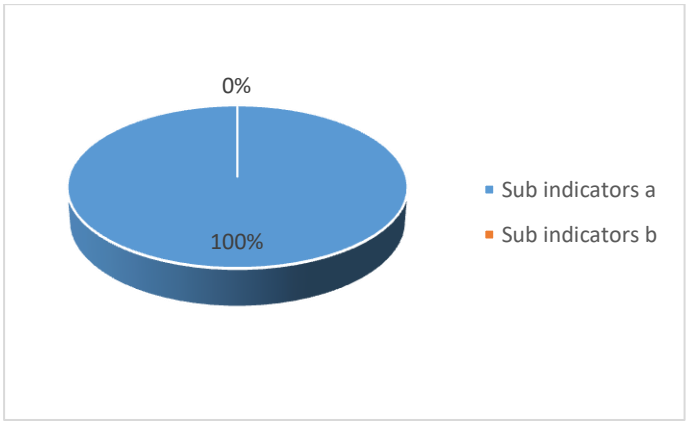

Fig. 4. The emergence of literacy components in science as interaction of sciece, technology an socienty

b. Reseach result on the science literacy component of instructional material Y

The first part of research on teaching material Y about component of science literacy based on indicators science as body of knowledge in chapters 4, 5 and 6. The appearance of the deep literacy component is seen in figure 5. As can be seen in Figure 5 that of emergence of literacy sub indicator in chapters 4,5 and 6 based on sub indicator a which presents facts, concepts, principles and laws containing as many as 92 statement items has a percentage of 98% , then indicator b which presents hypotheses, with a statement of 1 item with 2% then indicator c with theorie and model. Make students to remember knowledge and information, science literacy does not occur here.

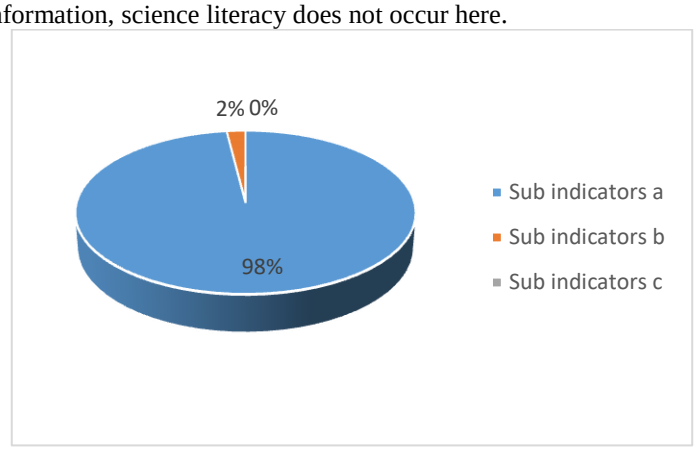

Fig. 5. The emergence of literacy components in science as a body of knowledge

The second part of research on teaching material Y about component of science literacy based on indicator science as the nature of science investigations in chapters 4, 5 and 6. The appearance of the deep literacy component is seen in figure 6. As can be seen in Figure 6 that the emergence of science literacy in the indicator science as a way to investigate in chapters 4, 5 and 6 in sub-indicator a with a percentage of 86% with 7 statements, and sub-indicator b of 0% with the number of questions is 0 items, then the c sub-indicator is 6% with 2 statements, then the d sub-indicator is 4% with a total of 1 question. And the last is the sub-indicator e with a percentage of 4%, with the number of questions 1.

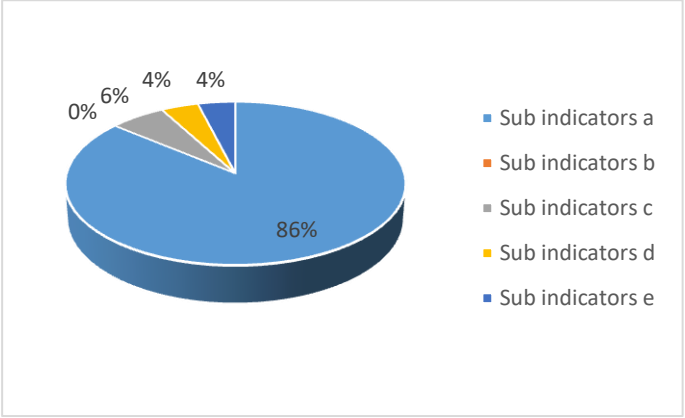

Fig. 6. The emergence of literacy components in science as the investigative nature of science.

The third part of the research on teaching material Y about components of science literacy based on indicators sains as a way of thinking in chapters 4, 5 and 6. The appearance of the deep literacy component is seen in figure 7. As can be seen in Figure 7 that in chapters 4, 5 and 6 which were examined by researchers the emergence of science literacy was only in indicators f and h with a percentage for indicator f of 26% with a total of 2 questions, and for sub-indicator h as much as 74% with a total of 5 questions.

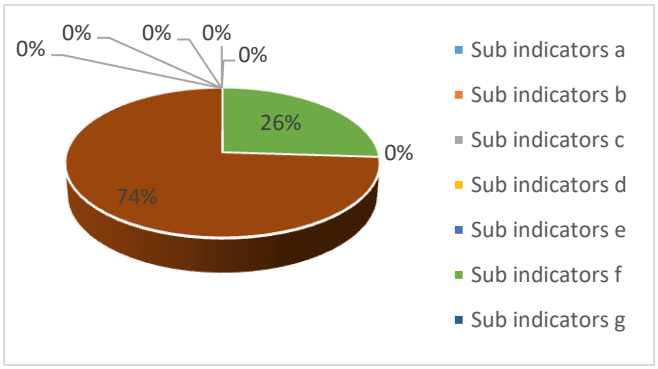

Fig. 7. The emergence of literacy components in science as a way of thinking

The fourth part of the research on teaching material Y about components of science literacy based on indicators science as interaction of sciece, technology an socienty in chapters 4, 5 and 6. The appearance of the deep literacy component is seen in figure 8. As can be seen in Figure 8 that science literacy only appears in the d sub-indicator of 0.76% as much as 1 statement, meanwhile in the other sub-indicators there is no occurrence of science literacy, therefore the emergence of science literacy in indicator e is considered 100%.

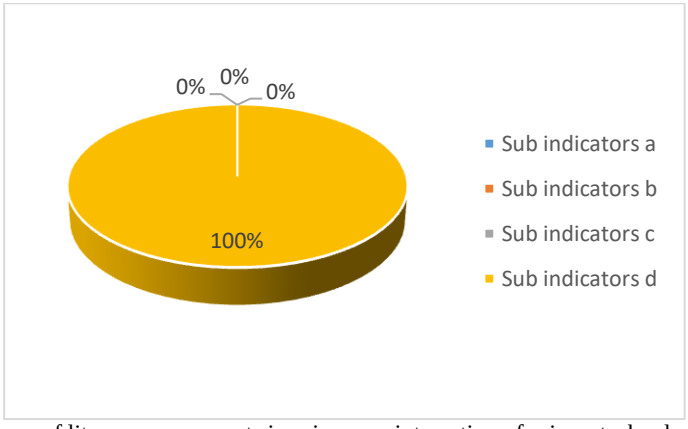

Fig. 8. The emergence of literacy components in science as interaction of sciece, technology an socienty

c. Reseach result on the science literacy component of instructional material Z

The first part of research on teaching material Z about component of science literacy based on indicators science as body of knowledge in chapters 4, 5 and 6. The appearance of the deep literacy component is seen in figure 9. As can be seen in Figure 9 that the percentage of occurrence of the literacy sub-indicators in chapters 4,5 and 6 is based on sub-indicator a which presents facts, concepts, principles and laws which contain as many as 57 statement items with a percentage of 90% , then indicator b which presents hypotheses, with a statement of 6 items with 10% then indicator c with theorie and model. Make student to remember knowledge and information having science literacy statements does not show science literacy.

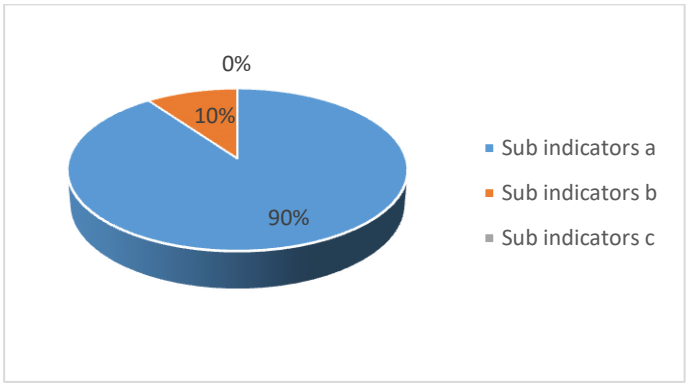

Fig. 9. The emergence of literacy components in science as a body of knowledge

The second part of research on teaching material Z about component of science literacy based on indicators science as the nature of scientific investigations in chapters 4, 5 and 6. The appearance of the deep literacy component is seen in figure 10. As can be seen in Figure 10 that the emergence of science literacy in the indicator science as a way to investigate for chapters 4, 5 and 6 in sub indicator a with a percentage of 27% with 4 statements, and sub-indicator b of 20% with the number of questions is 3 items, then sub-indicator c is 33% with 5 statements, then sub-indicator d is 14% with a total of 2 questions. And the last is the e sub-indicator with a percentage of 0, which means that there is no science literacy in the e-sub-indicator.

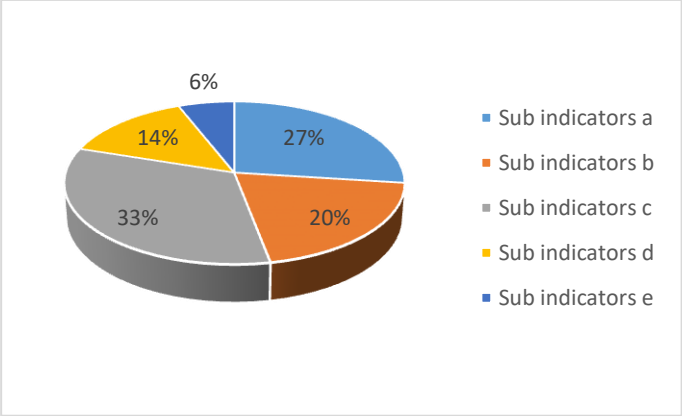

Fig. 10. The emergence of literacy components in science as the investigative nature of science

The third part of the research on teaching material Z about components of science literacy based on indicators sains as a way of thinking in chapters 4, 5 and 6. The appearance of the deep literacy component is seen in figure 11. As can be seen in Figure 11 that in chapters 4, 5 and 6 which were examined by researchers, the appearance of science literacy was only in indicators c and f with a percentage for indicator d of 20% with a total of 1 question, and for sub-indicator f as much as 80%. with a total of 4 questions. And for the other indicators, namely sub-indicators a, b, c, e, g and h, science literacy was not found.

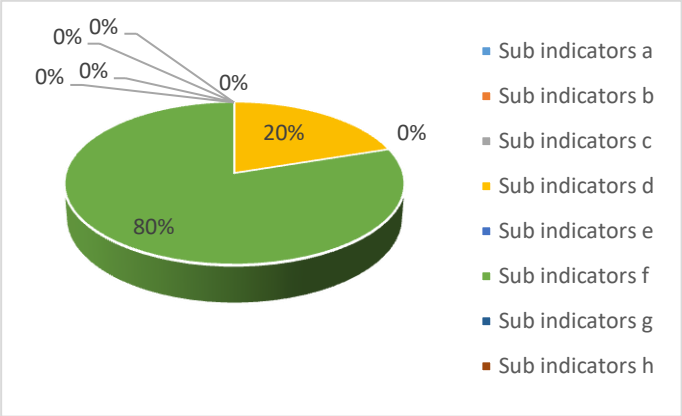

Fig. 11. The emergence of literacy components in science as a way of thinking

The fourth part of the research on teaching material Z about components of science literacy based on indicators science as interaction of sciece, technology an socienty in chapters 4, 5 and 6. The appearance of the deep literacy component is seen in figure 12. As can be seen in Figure 12 that science literacy only appears in sub-indicator a of 4.57% in 4 statement items, meanwhile in other sub-indicators there is no occurrence of science literacy, therefore the emergence of science literacy in indicator a is considered 100%.

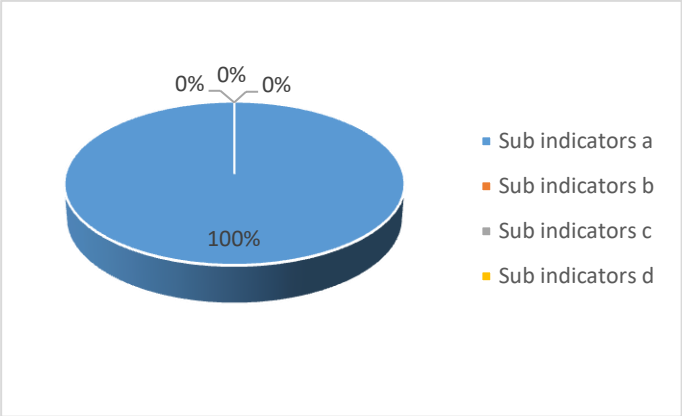

Fig. 12. The emergence of literacy components in science as interaction of sciece, technology an socienty

The analysis of this study is the problem of science literacy in physics instructional material for class X at high school in Padang City. There are four components of science literacy that are analyzed in physics textbooks, namely science as a body of knowledge, as a way of investigating, as a way of thinking, and the interaction of science, technology and society.

1) Scientific as a body of knowledge

Aspects in the sense of the word science as a source of knowledge. This aspect contains the function to display, discuss or ask things to remember information about facts, concepts, principles, laws, theories, and so on. This will reflects the transmission of science knowledge as students receive information. This category is a feature of most textbooks and indicates information that must be studied. The material in the books analyzed in this study emphasizes the category of scientific knowledge or science as a body of knowledge. Presentation of material containing many fact, concept, principle, law, and question to help students recall knowledge and information, the percentage of indicators of scientific knowledge gets the highest percentage compared to other indicators. In other words, the indicator of science as knowledge has presented the most science literacy with an average percentage of each teaching material, for instructional material x, y and z of 90.93%, 59.90% and 80%. Measurement of scientific literacy is not only important for mastering the extent to which students understand science knowledge, but also an understanding of various aspects of the science process, as well as the ability to apply scientific processes in real situations [6].

2) Science as a way of investigating

The indicators of science aim to explore and develop students' ways of thinking and provide something that makes students act to investigate and find out about the material being taught. This aspect reflects inquiry and active learning, and involves students in scientific processes such as observing, measuring, classifying, drawing conclusions, recording data, performing calculations, and conducting experiments. In this study, the emergence of science literacy is in the second part, with the acquisition of the percentage of each teaching material which is not too much different. The emergence of literacy components in the three instructional material x, y and z on this indicator is 33.33%, 23.14% and 17.15%.

Student learning habits can be seen from learning activities and can be carried out continuously at any time. The study habit affect learning achievement, because the learning achievement obtained by students has many influencing factors, one of which is student learning habits [7]. Students very rarely have special free time to study at home so learning at school must really be made effective so that students' science literacy skills can be developed. Learning in class X natural sciences focuses on activities to work on questions independently, so the selection of questions must be considered carefully, choosing questions that do not only include one indicator of science literacy but must balance the level of each indicator of science literacy on each question [8]. This is in line with mastery of science literacy which is very necessary because it is very important for everyone to solve problems [9].

3) Science as a way of thinking

Is one indicator that leads students to think and discuss scientific activities directly. Sains adalah aktivitas manusia, ditandai dengan proses berpikir yang terjadi di kepala mereka yang terlibat. Science is a science that includes experimentation and discovering something new that comes from life.

Emphasize empirical nature and objectivity, assumes, and shows science works in inductive-deductive reasoning, provides causal relationships, discuss a fact, and presents science methods and problem solving. In study, the emergence the literacy component in as a way of thinking was ranked third with the percentages for the total for instructional material x, y and z being 24.04%, 6.42% and 4.57%.

What has been learned to solve problems experienced daily life of students [10]. Fromthe research results increasing science literacy skill can be done by applying a scientific approach in the learning process [11]. Students will enjoy knowledge, find connections, increase their creative abilities and responsibilities in solving everyday life problems through learning with a scientific approach [12]. In the scientific approach syntax, exploratory activities can be carried out with practicum activities. Science literacy process activities in the form of practical activities can attract students' curiosity and strengthen students' understanding of concrete knowledge through experiments [13].

The low ability of students' physics literacy skill during the covid19 pandemic provides information that the online learning process should also pay attention to the development of students' physics literacy abilities. Therefore, it is necessary to have practical activities based on science literacy to improve students' science literacy skills even though they are carried out online [14]. This is necessary because scientific literacy is knowledge about science that makes scientific knowledge as a basis for thinking and being able to formulate about the relationship between natural and human phenomena that ends with withdrawal conclusion [15].

4) Interaction of science, technology, and society.

In this indicator scientific gives an impact of science on society. Aspect that is being developed is the application of science, and how technology helps and bother people. In addition, this aspect accompanies students in social issues that develop in society. Are students interested in receiving this information and investigating the truth of the issue. If a literacy process on this indicator is developed, the science literacy components refer to the dimension of scientific context that represents everything related to science and technology in everyday life. And this will be of particular interest to students in working on the questions in class X physics instructional material.

However, in this study, the emergence of science literacy is the fourth or last order, in the sense of the words the indicator of the interaction of science, technology, and society is indicator raises the least science literacy, the result of each teaching material x, y and z, 3.33%, 0.76% and 4.57%. In this way, this teaching material needs to be redeveloped so that science literacy appears more in the questions given to students.

Integration of science, technology, and society in physics learning can build knowledge that influences scientific activity and contributes to deepening and consolidating students' knowledge [16]. A student success in learning science literacy can be measured by whether or not the student scores on a test given by the teacher. The result of this assessment can be used as evaluation material for further learning.

This statement is in line with the assessment to measure the achievement of student learning outcomes, evaluating processes, learning progress, improving learning outcomes, and improving student learning outcomes in a sustainable way [17]. The importance of assessment scientific literacy ability of each individual to make it easier to know the extent his understanding of the sciences and devising appropriate strategies for used to improve achievement, especially in the field of science [18].

Measurement of science literacy is important determine student understanding of the concepts being studied. Therefore we need a science literacy instrument. Science literacy instrument already exist and can be used from international research such as PISA. However, the result on Indonesian science literacy in international studies apply in general. Given the diversity of deficiencies in achieving the level of science literacy of students and curriculum at the level of educational units adapted to the regions and specifications of science lessons. Need to develop science literacy instrument for use in a small scope [19]. This is necessary because science literacy is believed to be one of the ways to achieve 21st century skills [20].

This is in line with the development of important scientific literacy because it relates to the benefits obtained for society, science, and the country as well as in improving the lives of individuals [21]. As well as literacy skills science students will be awakened with itself and will develop over time the learning process takes place with the help of the teacher and the instructional material used [22]. So that later it will create students who have science literacy. Scientifically literate students are students who have knowledge as a provision for understand science facts, their relation to science, technology and society as well apply their knowledge to solve various problems in life real [23].

IV. CONCLUSION

The emergence of science literacy in instructional material X, Y, and Z, on average, is almost the same for each of the sub-indicator results. The emergence of the highest literacy in the indicator science as a body of knowledge with an average percentage of 90.93%, 59 and 80%. That way for indicators of scientific knowledge it is known that they already have a percentage value above 50%. The second emergence of science literacy is in the indicator of science inquiry, with an average of 21.85%, 21.24% and 4.57%. The emergence of the third science literacy is in indicators of as a way of thinking with an average of 24.07%, 6.42% and 4.57%. And for the lowest percentage there are indicators of interaction, technology and society with percentages of 3.33%, 0.76% and 4.57%. 5. The three lowest indicators have not reached literacy above 50%, because it need to develop these three instructional material.

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