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The profile of biology teaching and learning materials from scientific literacy perspective



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ABSTRACT

Many researchers have developed scientific literacy, but no one has done scientific literacy study on biology teaching materials that include environmental change materials. The purpose of this study is to assess scientific literacy in senior high school biology teaching materials utilized by teachers in Palembang's Ilir Barat I district. This research was conducted using biology teaching materials in the form of books and modules used by teachers in grade X in 13 senior high schools in Ilir Barat I district, Palembang, both in public and private schools. This study employed a descriptive technique with content analysis, which included collecting and assessing biology teaching materials for senior high school grade X. All biology teaching materials for grade X of senior high school utilized in Ilir Barat I district Palembang were used as the population in this study, with environmental changes in biology teaching and learning materials for grade X of senior high school as the sample. The findings revealed that the scientific literacy category was represented in the teaching materials used in 13 senior high schools in the district of Ilir Barat I Palembang, with an average percentage of 34.24% for the body of knowledge, 45.35% for a method of investigation, 9.75% for a method of thinking, and 10.86% for the category of science, technology, and society interaction.

10

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INTRODUCTION

Science and technology advancements affect the aspects of world education today. This has led to intense competition from various countries to raise the standard of human resources. In relation to the improvement, education holds important role in it by preparing the next generation



of the nation who is competitive in the international level. This is in accordance with the statement (Kristyowati and Purwanto, 2019), which explains that education has a very large role in creating national next generation and in the international world competition. Science is one of the disciplines taught in high school that plays a significant role in preparing students to face the problems of the global era. As a result, scientific courses are required to guide pupils toward competence and science literacy.

Scientific literacy competence is a term used to describe a person's ability to comprehend science, communicate scientific ideas, and apply scientific skills to solve problems in order to maintain a positive attitude and sensitivity toward themselves and their environment when deciding on the basis of scientific evidence (Yuliati, 2017). Scientific literacy is a very important thing to master by every individual (Sandi, 2014) because it is closely related to one's understanding of the environment and other problems that exist in modern society and greatly affects science and technology advancements, as well as social community development

Scientific literacy can be the basis for someone to take an action by taking into account the possible causes and effects, so that scientific literacy is not only influential in Science and technology advancements, but it also has a wider influence in life. Students will be able to do more if they have high literacy skills such as master science and technology that are very useful for themselves, society, and the nation in a wider scope (Puskurbuk, 2017; Klein, 2006; Holbrook & Rannikmae, 2009; Waki'a, 2021).

According to the findings of the PISA scientific literacy research, which is conducted every three years, Indonesian students' scientific literacy capacity to compete at an international level still needs to be improved. Even recently, Indonesia has lagged far behind and occupies the last position compared to other participating countries. The latest PISA data in 2018 shows that the scientific literacy of students in Indonesia was ranked 72 out of 77 participating countries with a score of 396 (OECD, 2019). There are many factors influencing the low scientific literacy of students. One of the factors is the selection of teaching materials. This is in line with the statement (Ginting & Suriani, 2018) which elaborates that one of the factors that directly intersect is the learning resources which is the materials used in teaching and learning activities.

Poedjiadi (Pratiwi, 2019) said that science is a group of knowledge about objects and natural phenomena obtained from the thoughts and research of scientists who are carried out with the skills of experimenting using scientific methods. The Ministry of National Education Curriculum Center (2007) stated that science is closely related to how to learn science is not only the mastery of a collection of information in the form of facts, concepts, or principles, but also a process of discovery about nature in a methodical way. It can be concluded that teaching materials, particularly science, of which biology is one, must present themselves as dynamic science, containing knowledge or facts, scientific terms, and a set of science process skills to solve various issues or scientific problems, as well as their applications in everyday life.

Several studies on scientific literacy content in student textbooks have been carried out by Ardianto et al. (2017) for science books used by students in Bogor, Rokhman et al. (2017) who analyzed science literacy in high school physics books and Puspita et al. (2021) who analyzed scientific literacy in books on the topic of natural disasters in high school. All these studies show the same thing that the textbooks used by students emphasize more on science as the body of knowledge, and there has been no specific research on biology textbooks used by students in Palembang, especially class X of senior high school. Given the importance of scientific literacy as a provision for students facing various challenges in the global era as an effort to understand science, communicate science (oral and written), and solve problems so that Because students have high attitudes and sensitivity to themselves and their surroundings when making decisions based on

scientific considerations, the authors feel that study on scientific literacy in currently accessible Biology teaching materials is important.

The study's problem is defined as follows: "How is the profile of biology teaching materials for senior high school grade X based on: (1) science as a body of knowledge; (2) science as a means of exploring; (3) science as a way of thinking; (4) interaction of science, technology, and society?" Furthermore, the goal of this research is to determine the profile of biology teaching materials for senior high school grade X based on: (1) science as a body of knowledge; (2) science as a method of investigation; (3) science as a method of thinking; and (4) science, technology, and society interaction (Chiappetta et al., 1993).

RESEARCH METHODS

Research Design

From the perspective of scientific literacy, this study used a descriptive method by analyzing the suitability of the scientific literacy category descriptor, which was described in the form of a description of the profile of biology teaching materials for grade X of senior high school in Ilir Barat I district Palembang. In the first semester of the 2019/2020 academic year, this study was conducted in 13 public and private senior high schools in the Ilir Barat I area of Palembang.

Population and Samples

The population in this study were all Biology teaching materials for Class X of Senior High School used by 13 schools in Ilir Barat I District, Palembang. The sample was the biology material of senior high school Class X on Environmental Change in Ilir Barat I Subdistrict, Palembang used by in classroom teaching and learning activities. Based on the results of the initial survey, there were 5 textbooks used in 13 high schools at the district. They were then named textbooks a, b, c, d and e.

Instruments

The instruments for assess the context of scientific literacy in the book was modified from Udeani (2013). This instrument is divided into four main indicators, namely Science as a body of knowledge, science as a way of thinking, science as a way to investigate, and the interaction of science, technology, and society which is divided into sub-indicators can be seen in Tables I

Table I. Indicators and sub-indicators science literacy

Science as body of knowledge	Science as a way of thinking	Science as a way to investigate	Interactions of science, technology, and society
Presenting fact	Presenting some question or task for asking by student	Describe the scientist to do when doing experiments	Describe the use of science and technologies for society
Presenting concept	Some task in the book, asking student to create table for answer	Showing a history about scientific theory or concept	Showing the negative effect from science and technologies for society
Presenting principle	Some task in the book asking student to create diagram for answer	Emphasize empirical study in scientific knowledge	Discussion about social issue in science and technologies
Presenting scientific law	Some task in the book need a reason for answer	Emphasize objectivity in science knowledge	Describing career in science and technologies
Presenting hypothesis	Some task in the book need student's hands on	Presenting fact and the prove	Explaining about the link for figure out relevant



activity for answer	material for advance learning
Presenting theory	Presenting scientific method
Presenting model for problem solving	Presenting scientific problem solving
Presenting a scientific issues in daily life	
Presenting a scientific question	

Procedures

The study approach was separated into three stages: preparation, implementation, and completion, with data gathering techniques such as documentation and interviews used in each stage.

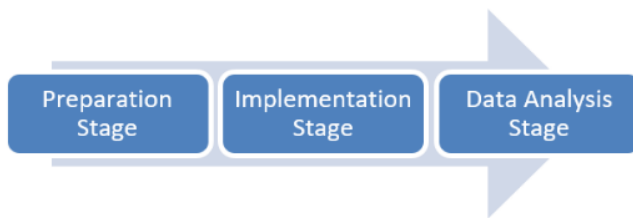


Figure 1 Research Flow Chart

The explanation of Figure I is as follows: (1) the preparation stage, consisting of theoretical studies, formulating problems, collecting information from various sources, selecting biology teaching materials with the following criteria: standardized by ISBN and verified by National Book Centre Pusbuk, and sampling stage with multistage sampling technique. (2) the implementation stage, analyzing each paragraph, matching it with the scientific literacy indicators on the scientific literacy indicator instrument sheet, and counting the occurrences of the existing indicators by tally. (3) the data analysis stage, the analyzed data, collected using scientific literacy indicator instrument sheets and interviews, were then described.

Data Analysis

The data which were further analyzed were the biology material discussed in the grade X. The data were carried out by qualitative analysis. Then, based on tally or tables the data were analyzed descriptively by grouping the data according to the research problem. In addition, to determine the percentage of occurrences of the scientific literacy category in biology teaching materials, the following data analysis was also carried out (Kurnia, 2014):

1. Summing up the occurrences of scientific literacy indicators for each category in each of the analyzed teaching materials.
2. Calculating the percentage of occurrences of scientific literacy indicators for each category in each analyzed teaching material. The percentage calculation was done using the following calculation formula:

$$P = \frac{\text{Number of indicators per category}}{\text{Number of indicators total category}}$$



The calculation results were entered in the form of a percentage according to the assessment criteria. After getting the highest and lowest percentages, the next step is to determine the class interval (Ariningrum, 2013). The calculations to calculate class intervals:

$$= \frac{\% \text{ the highest} - \% \text{ the lowest}}{\text{the choosen class}}$$

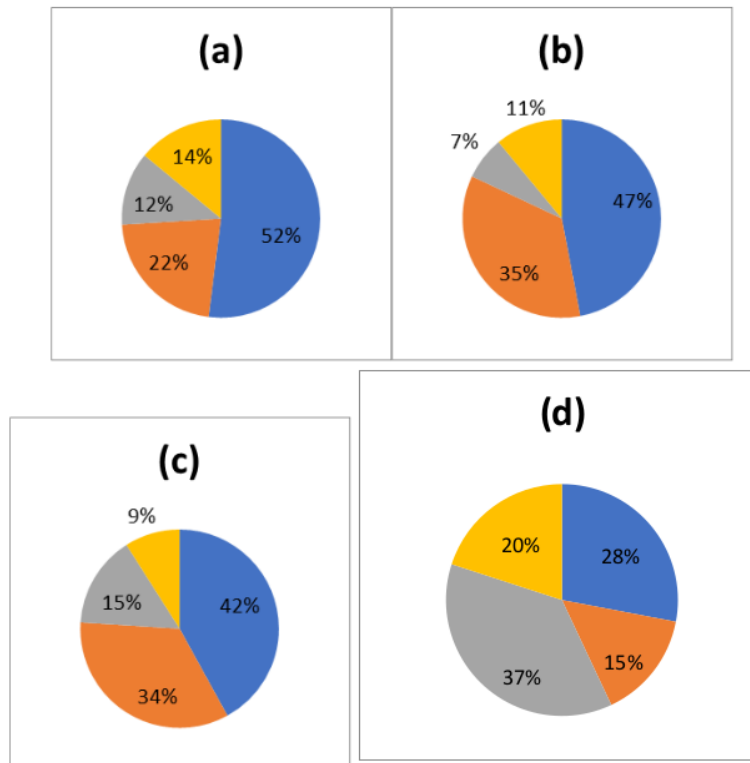
The following assessment criteria were obtained

Table I the percentage of science literacy level for biology teaching

Interval	Criteria
81.25% < X ≤ 100%	Very Good
62.5% < X ≤ 81.25%	Good
43.75% < X ≤ 62.5%	Fair
25% < X ≤ 43.75%	Not Good

RESULTS

The proportion of occurrences of scientific literacy categories in teaching materials, as well as the pages where scientific literacy categories were identified in teaching materials, were the findings of the study. The findings of the study on the profile of biology teaching materials revealed that biology instructors in Ilir Barat I district Palembang utilized five teaching materials, including one module and four textbooks published by various publishers. The following Figure I demonstrates this:



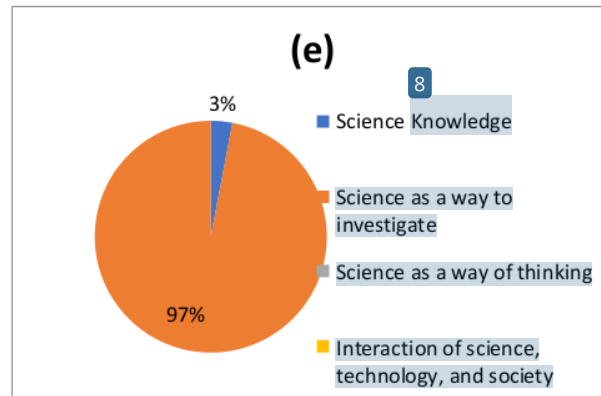


Figure 1 the percentage of occurrences of scientific literacy categories in: (a) Teaching materials A; (b) Teaching materials B; (c) Teaching materials C; (d) Teaching materials D; (e) Teaching materials E.

DISCUSSION

Teaching and Learning materials have an important role in learning science, because they can be used as the main resource to optimize the learning process. The teaching materials used in the learning process are expected to have integrated balanced scientific literacy so that later it is expected to improve scientific understanding and build students' scientific literacy competencies (Mariyah, 2014). Based on the research data, it can be seen that the overall teaching materials analyzed have included all categories of scientific literacy, but overall, the five teaching materials have different percentages of occurrence.

Teaching materials A, B, and C were more dominant in emphasizing material on scientific knowledge as the body of knowledge, meanwhile for teaching materials D, they emphasized the category of scientific literacy as a way of thinking as a more dominant category in the presentation of teaching materials. On the other hand, teaching material E had an uneven proportion of scientific literacy categories because one of the categories, science as a way to investigate, had a fairly large proportion compared to the other three categories of scientific literacy. The main cause of the difference in the number of occurrences of scientific literacy categories in the five teaching materials studied was that teaching materials A, B, and C were very much presented in the form of definitions, concepts, and facts. It is different with teaching materials D and E. In teaching materials D tended to emphasize more on the category of science as a way of thinking and in teaching materials E it placed great emphasis on the category of science as a way to investigate so that teaching materials tended to present a large number of assignments and exercises.

The analysis of scientific literacy categories for the five teaching materials was carried out by analyzing teaching materials with basic competence 3.II regarding environmental changes which were applied to biology class of grade X in odd semester in senior high school. The average appearance of the largest scientific literacy category from the five teaching materials was the first scientific literacy category compared to other scientific literacy categories, namely science as the body of knowledge because in the presentation of the teaching materials it presented more scientific knowledge in the form of theories, definitions, concepts, models, and basic knowledge of the material. This is in accordance with the explanation according to the OECD which stated that the main explanatory ideas are needed to explain scientific and technological phenomena which can be in the form of explanations of theories, concepts, models, and principles (OECD, 2016). This result is also not different from the results of a similar study conducted by Ginting & Suriani (2018) who conducted an analysis of the level of science literacy for biology textbooks for grade

XI of senior high school in Pancurbatu district on nervous system material based on 4 dimensions of scientific literacy and stated that the category of science as stem the most dominant body of knowledge appeared in the textbooks, they study with a percentage of 77.20%.

Thus, the component of knowledge, or the dimensions of science content, was stressed more in the grade X biology teaching materials utilized by teachers in Ilir Barat I district Palembang. Biology teaching materials should not only provide biology content, but also allow students to explore their own knowledge, comprehend the critical role of biology in social issues, and build particular understandings. This category characteristic will have an influence on students who are strong at remembering but not at applying their information; this might be connected to pupils who utilize their memory as a tool to master science rather than their ability to think (Ardianto & Pursitasari, 2017). Sandi (2014) said that if the composition of the presentation of the category of science knowledge is greater, it is feared that it will affect the learning system of the students themselves or learning in the classroom. So that learning will only focus on science content rather than scientific processes and build their own way of thinking and scientific investigation.

In relation to the nature of science, the category of scientific literacy as a way of thinking and science as a way of investigation was included in the dimensions of the scientific process. Based on this, it can be said that the composition of the scientific literacy category that represents the scientific process appeared quite a lot in the biology teaching materials that have been studied. Thus, in addition to presenting scientific knowledge, these teaching materials were generally quite capable of developing the scientific process abilities of students, in this case related to scientific investigations and ways of thinking.

According to the facts in the field, the category of science as a way of thinking was the category that was at least presented in the five teaching materials that have been studied. When the way of thinking that students have was low, it is possible that students will find it difficult to place science in real life so that the ability to understand the interaction of science, technology, and society will not develop optimally.

The results of the study showed that there were very few situations that invite students to think higher, such as in presenting cause-and-effect relationships of a problem topic or discussing facts and evidence from environmental problems so that later students are expected to upgrade their thinking and knowledge in prevention of environmental pollution.

This is different from research (Murradiyah & Rusilowati, 2015) which was taken from the textbooks analyzed. It showed the category of science as a way of thinking was the second largest category after science as a body of knowledge with a percentage of 19.08%. Furthermore, from research conducted (Leonard & Penick, 1993) it also said that science lessons should emphasize more on student activities, reduce activities that only remember knowledge in the form of facts, emphasize science process skills to get concepts and active learning.

Thus, in general, the analyzed teaching materials have shown all aspects of scientific literacy. These teaching materials have reflected scientific literacy even though the proportions were not balanced because only one out of the several categories that appeared in the study, namely scientific knowledge. Scientific literacy in teaching materials should be provided in four categories: science as a body of information, science as a method of investigation, science as a method of thinking, and the interplay of science, technology, and society on current content or material. The unequal scope of scientific literacy, which is classed as extremely low in science books, has an impact on pupils' scientific literacy (Lasminawati, 2019).

CONCLUSION

According to the results, science as a body of knowledge, science as a method of investigation, and science as a system of thought scored 34.24 percent (pretty good), 45.15 percent



(fairly good), and 9.75 percent (bad) accordingly. The presentation of the scientific literacy aspect of the interaction of science technology and society occurred with a percentage of 10.86%, which is in the poor category. This aspect of application and attitude of science should be raised more, such as the negative effects of science, socio-cultural impacts and limitations of science. This research data can be a useful input for future research on the development of biology textbooks so as to take notice to the balance of the other three aspects of scientific literacy, i.e., science as a way of thinking, science as an attitude and aspects of the interaction between science and technology and society.

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