

## Analysis of Science Literacy Aspects of High School Biology Textbooks: Especially on Endocrine System Material

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### Abstract

*Biology lessons for class Learning carried out by teachers to students is considered important because it is in accordance with the concepts, ideas and processes that must carry out the implementation of a plan that has been prepared carefully and in detail. This research aims to analyze 2 textbooks used in carrying out learning, including: 1) books biology for Second grade of senior high school level (SMA/MA) by Djubaedah and Purnami with publisher Grafindo Media Pratama; 2) Biology book for Second grade of senior high school level by Irmaningtyas and Istiadi with publisher Erlangga. This research uses qualitative methods with data analysis in this research using descriptive statistics. The scientific literacy analysis is intended to determine the level of scientific literacy in Second grade biology textbooks. Analysis was carried out by calculating the percentage of scientific literacy in each book analyzed. This results that the level of scientific literacy in biology textbooks of Second grade of senior high school level on endocrine material used at MAPN 4 Medan is quite good according to the assessment criteria. The scientific literacy that often appears in the analyzed biology textbooks is science as a body of knowledge, followed by science as a way of investigation, science as a way of thinking and science and its interaction with technology and society*

**Keywords:** *Biology textbooks; Endocrine; Science*



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## INTRODUCTION

Indonesia is one of the countries that participate in the International Student Assessment Program (PISA). Outside of highly developed industrial nations that are members of the Organization for Economic Co-operation and Development (OECD). [The Organization for Economic Co-operation and Development-OECD \(2010\)](#) organizes the PISA program, which assesses student performance literacy in reading, math, and science at the youthful age of 15. Several developed and developing countries have implemented this program at three-year intervals since 2000. In its implementation, from 2000 to 2018, the average scientific literacy score Indonesian students are still below the average proficiency score set by PISA ([Merta et al., 2020](#)). Students in Indonesia still do not understand the concept of science or the application of science itself in everyday life.

Based on the explanation above, it appears that the literacy skills of Indonesian students really need attention, especially by educational practitioners. The inadequate outcomes of Indonesian students' scientific literacy abilities are caused by several factors, one of which is the textbooks that students use in studying. It could be said that books are one of the main sources for educators in implementing the learning process. Books are an important component in the learning process. Textbooks or textbooks are also the most widely used teaching materials among all other teaching materials ([Meuthia et al, 2021](#); [Adisendjaja & Romlah, 2007](#)). For this reason, when selecting textbooks or textbooks, educators must pay attention to or consider several feasibility factors in selecting books, one of which is the scientific literacy aspect.

The assessment of how much scientific literacy a book contains can be seen from the aspects of scientific literacy ([Agustin & Supahar, 2020](#)). There are four aspects that can be used as indicators in assessing the scientific literacy content of a book, namely science as a source of knowledge, science as a method of investigation, science as a mode of thought (science as a mode of thought), and the interaction between science, technology, and society ([Ariningrum, 2013](#)).

Textbook research on scientific literacy components has indeed been carried out by [Nurfaidah \(2017\)](#), the results of her research show that the summary of scientific literacy is distinct, with 5.8% focusing on the science aspect as a method of thinking and 1.2 % on the science interaction aspect, technology, and society. Each chapter still only provides a partial presentation of two topics. In fact, only Chapter 7 (7.4 %) and Chapter 4 (0.5 %) discuss how science, technology, and society interact. The following findings show that this book does not emphasize material that supports mastery of processes and context. In research conducted by [Ramnarain & Padayachee \(2015\)](#) on aspects of scientific literacy in Biology books, it shows the difference between both of the new science textbooks. the biology textbooks developed for the former curriculum accurately depict the nature of science and adhere to the independent curriculum statement ([Kemendikbud-Ministry of Education and Culture, 2024](#)).

Based on an initial survey conducted directly by the author with Mrs. Nurul Huda as a biology teacher at Senior high school of MAPN 4 Medan using textbooks

as a learning resource. One of the materials contained in the science books that were examined from the two biology textbooks at MAPN 4 Medan was about the endocrine system in humans. The material on the endocrine system in humans is important material for Second grade of senior high school level to be discussed. This is because it is directly related to human body systems that occur in everyday life. Apart from that, [Aditya & Indana \(2022\)](#) state that as the science material, the endocrine system in humans also contains various theories, concepts, presentation of tables and graphs, as well as developments in science and technology which constitute most of the coverage of the indicators of the scientific literacy component.

Biology lessons for class Learning carried out by teachers with students is considered important because it is in accordance with the concepts, ideas and processes that must carry out the implementation of a plan that has been prepared carefully and in detail. Science concepts must be used through learning that is close to everyday life. Students can master scientific literacy if stimulated with a science process skills approach ([Toharuddin, 2011](#)). The assumption is that the science process skills possessed can be used as provisions for students in making decisions regarding problems related to the environment, interactions with science, society and socio-economic development.

The solution that teachers can take to provide scientific literacy is to integrate scientific literacy in every learning process. The planned material must be designed through experimental activities in science ([Adnan et al., 2021](#)). Planning activities in experiments in science. Endocrine system material must be contextual and familiarize students with direct observation of scientific objects so that students can gain experience.

Based on the background above, the author is interested in conducting research related to the title analysis of aspects of scientific literacy in high school biology books on endocrine system material. It is hoped that the results of this analysis can improve the quality of biology textbooks in circulation, so that they can be based on scientific literacy and can be used as teaching materials for educators and students.

## **METHOD**

The research was conducted at the Senior high school of Madrasah Aliyah Swasta Persiapan Negeri 4 Medan (a.k.a MAPN 4 Medan), with a class XI biology textbook as the research subject. The material chosen for this research is endocrine system material. Researchers analyzed 2 textbooks used in carrying out learning, including: 1) Biology book for Second grade of senior high school level (SMA/MA Class XI) by Elis Djubaedah and Sri Endang Purnami with publisher Grafindo Media Pratama; 2) Biology book for Second grade of senior high school level (SMA/MA Class XI) by Dra. Irnaningtyas, M. Pd and Dr. Yossa Istiadi M.Si with publisher Erlangga.

This research uses qualitative methods with data analysis in this research using descriptive statistics. The scientific literacy analysis is intended to determine the level of scientific literacy in class XI biology textbooks. The analysis was carried out by calculating the percentage of scientific literacy in each book analyzed by observer

I (observer), observer II (biology teacher), observer III (biology lecturer), each observer consisting of 1 person. Based on the results of these calculated values, the following assessment criteria are obtained.

**Table 1.** Criteria for assessing the percentage of the total scientific literacy score for class XI biology textbooks (Elim et al., 2024)

Intervals	Criteria
$81.25 \% < X \leq 100 \%$	Very good
$62.50 \% < X \leq 81.25 \%$	Good
$43.75 \% < X \leq 62.50 \%$	Pretty good
$25.00 \% < X \leq 43.75 \%$	Not good

### Sample or Participant

This research was carried out by MAPN 4 Medan with a class XI biology textbook as the research subject. The material chosen for this research is endocrine system material. Researchers analyzed 2 textbooks used in carrying out learning, including: 1) Biology book for Second grade of senior high school level (SMA/MA Class XI) by Elis Djubaedah and Sri Endang Purnami with publisher Grafindo Media Pratama; 2) Biology book for Second grade of senior high school level (SMA/MA Class XI) by Dra. Irnaningtyas, M. Pd and Dr. Yossa Istiadi M.Si with publisher Erlangga. Data analysis was carried out on 3 observers, namely observer I (observer), observer II (Biology Teacher), Observer III (Biology Lecturer).

## RESULT AND DISCUSSION

### Research result

The scientific literacy analysis of the biology textbook of MAPN 4 senior high school was carried out to determine the level of scientific literacy in the Second grade (class XI) biology textbook of MAPN 4 on endocrine material. The textbooks used in the research were selected based on the 2013 curriculum. From the results of the book selection, 2 books were obtained which were used as research subjects. The two textbooks were then labeled book I and book II. The results of the scientific literacy assessment research from the two class of Second grade biology textbooks on endocrine material are on table 2 & 3.

### Discussion

The overall average percentage of scientific literacy dimension assessment results in the two textbooks which appeared most frequently was scientific literacy as a body of knowledge at 44.1 % and in the second book at 40.8 %. This dimension appears most often in the content of textbooks according to the research results of Çobanoğlu & Şahin (2009); Chabalengula et al., (2008) which shows that the dimension/literacy of science as a body of knowledge (science as a body of knowledge) appears most frequently in the textbooks they analyzed. This dimension places more emphasis on knowledge of information from the products of scientists'

thoughts which include facts, concepts, principles, laws, theories, models and hypotheses (Chiappetta & Koballa, 2010). In this literacy, researchers examine paragraph texts which fall into the categories of facts, concepts, principles, models, laws, theories and hypotheses of science (biology) as well as questions and discussions related to endocrine material. The two books analyzed, both emphasized scientific knowledge/information in their material content and what appeared most often were the categories of facts, concepts and scientific models (biology).

**Table 2.** Percentage of Scientific Literacy Dimension Scores in Book I

No.	Dimensions of Scientific Literacy	Observer I (%)	Observer II (%)	Observer III (%)	Average (%)
1	Science as the body knowledge	47.5	37.5	47.5	44.1
2	Science as a way of thinking	25.0	27.5	25.0	25.83
3	Science as a path of investigation	37.5	32.5	35.0	35.0
4	Science and its interactions with technology and society	25.0	25.0	25.0	25.0
Σ score percentage		135.5	122.5	132.5	129.99
Average of total score (x)		33.75	30.62	33.12	32.49

**Table 3.** Percentage of Scientific Literacy Dimension Scores in Book II

No.	Dimensions of Scientific Literacy	Observer I (%)	Observer II (%)	Observer III (%)	Average (%)
1	Science as the body knowledge	43.5	3.5	35.6	40.8
2	Science as a way of thinking	20.0	15.0	25.0	20.0
3	Science as a path of investigation	37.5	32.5	35.0	35.0
4	Science and its interactions with technology and society	20.0	25.0	20.0	21.6
Σ score percentage		121.0	116	108.1	117.4
Average of total score (x)		30.25	29.0	28.9	29.38

Scientific literacy as a way of investigation is the second literacy that is most emphasized in the two textbooks analyzed, namely 35 %. The results of this research are in accordance with the research results of Chiappetta & Filman (2007) where in the five books analyzed the dimension of science as a way of investigation (science as a way investigation) is superior compared to other literacies and this scientific literacy is widely used to encourage students to study science. Scientific literacy as a path of investigation is used to utilize several approaches to constructing knowledge (Chiappetta & Koballa, 2010). This activity is the basis for scientific activities and describes the scientific process which includes observing, guessing, hypothesizing, predicting, measuring, manipulating variables, calculating, experimenting and creating models. In this research, what is included in this category are experiments and direct activities that students can do to support understanding of concepts. In the



two books analyzed, the situations that appeared in the books were mostly practical activities, but there were few situations that invited students to use calculations and scientific inquiry activities and problem-solving using the science process.

Science as a way of thinking in both books has an average score of 25.83 % and in the second book it is 20%. This literacy shows how a scientist thinks and how scientists carry out experiments such as belief, curiosity, imagination, thinking, understanding cause-effect relationships, self-testing and doubt, objectivity and open-mindedness that underlie discovery and research (Chiappetta & Koballa, 2010). The results of the analysis show that there are very few situations that invite students to think higher either on questions or on the content of endocrine material. This is in accordance with research by Cobanoglu & Sahin (2009) which shows that the analyzed biology textbooks show that there are important errors/misconceptions in the textbooks and also do not provide inquiry questions and the approach taken is still rote. Textbooks should be used to initiate students' inquiry processes and attract students to carry out investigations because inquiry-oriented textbooks can stimulate students to be active, not just absorb information (Ruwanto, 2011).

Even though the average assessment results for these two books are low, the percentage of scores for the first book is higher than for the two books. This is because in the contents of the book there are many questions/situations that invite students to think according to this dimensional category, such as questions that attract students' curiosity and think critically based on existing phenomena.

In the books studied, very few texts present the dimensions of science and its interaction with technology and society. The average result is 25 %, while the second book only gets an average of 20 %. This literacy is related to the impact of science and technology on society, which will help humans or even damage the environment and have a negative impact on humans. This literacy shows how humans play a role in the development of science and technology and vice versa how science and technology help solve human problems. In both books, there is more emphasis on the positive impact (usefulness) of science and technology on society and less on the negative impact of science. A good textbook is able to connect each endocrine material with scientific research as well as science, technology and society by highlighting how aspects of science are carried out and the role of science in life (Campbell, 2010), as well as mentioning what is related to the material so that students have a view on related careers.

Scientific literacy as a body of knowledge is a literacy that often appears because in writing textbooks, writers and publishers place more emphasis on scientific knowledge such as concepts, facts, scientific principles as information that students must know and understand and less on improving students' thinking processes. This is supported by the research of Abdulkarim (2007) on textbook analysis and its implications in empowering high school students' thinking skills, showing that existing textbooks do not provide thinking stimulation and convenience for students towards understanding and improving critical thinking processes. In general, textbooks only cover general data, facts and concepts, not specific, actual and contextual matters with a high level of Bloom's taxonomy (Susilo, 2007). Textbooks do not have much contextual learning such as problem solving models,

inductive thinking, inquiry, critical thinking, and cooperative learning (Pujiyanti, 2022).

Textbooks as teaching materials and sources of information that are widely used by teachers and students should present scientific literacy in the contents of their books because textbooks are an important variable in successful learning. A good science textbook must describe science on every side well and correctly. Learning science is related to efforts to find explanations for natural phenomena. Textbooks can be used to improve the quality of students' science to become more scientifically literate and scientifically literate.

Scientific literacy in books should be presented in a balanced manner in the four scientific literacies, namely science as a body of knowledge, science as a way of thinking, science as a way of investigation and science and its interaction with technology and society in the content/material of the book. The balance of the four scientific literacies in book content/material will result in students' scientific literacy levels increasing which can also improve the quality of students' science education (Penny et al., 2003).

In this research, obstacles were also encountered, such as difficulties in entering elements of the text being analyzed into the scientific literacy category because it could be that the text being analyzed falls into another category. The assessment instruments used were made by the researchers themselves, so there are still some instruments used that do not assess scientific literacy in depth and comprehensively (Salsabila et al., 2022). In this study, only two observers/raters were used so that the expected results were still less than optimal. Apart from that, researchers also lack experience in this field so that other researchers are needed to obtain better data reliability and validity and observers still lack experience in their field (Rahayu, 2014).

## CONCLUSION

Based on the research results, it was concluded that the level of scientific literacy in second level (class XI) high school biology textbooks on endocrine material used at MAPN 4 Medan was quite good according to the assessment criteria. The scientific literacy that often appears in the analyzed biology textbooks is science as a body of knowledge, followed by science as a way of investigation, science as a way of thinking and science and its interaction with technology and society.

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