Volume 5 Number 2 (2023)
Mei-August 2023
Page: 256-270

E-ISSN: 2656-4491
P-ISSN: 2656-4548
DOI: 10.37680/scaffolding.v5i2.2819

SCAFFOLDING
Jurnal Pendidikan Islam dan Multikulturalisme

# ANALYSIS OF BIOLOGY TEXTBOOKS BASED ON SCIENCE LITERACY AT SENIOR HIGH SCHOOLS

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Submitted: 11/12/2022 Revised: 20/02/2023 Accepted: 10/04/2023 Published: 07/06/2023

**Abstract**

The purpose of this study was to describe the scope and calculate the level of science literacy in high school biology textbooks class XII based on science literacy. The science literacy categories used are science as a body of knowledge, science as the nature of inquiry, science as a way of thinking, and the interaction of science, technology, and society. This research is qualitative research with descriptive methods. There were four biology textbooks sampled in this study. The data used in this study used primary data. Primary data sources were obtained through direct surveys of the four schools. Secondary data was obtained through the internet on the school data page. The data collection method in this study uses the documentation method. The data analysis used uses content analysis, which is a technique for collecting and analyzing the content of a text. The results of data analysis showed that the category of science as a body of knowledge amounted to 55.3%, science as the nature of inquiry amounted to 10%, science as a way of thinking amounted to 34%, and the interaction of science, technology, and society amounted to 0%. The data illustrates that the class XII biology textbooks used by some schools have described science literacy with a good category. It's just that the books generally emphasize more on the aspects of science as a body of knowledge and less on present science and technology.

**Keywords** Biology, science literacy, textbooks

## INTRODUCTION

Science education is a science that teaches students the process of discovery. Science education is a means for students to understand and examine the environment, health, economics, and other issues facing modern societies that rely heavily on technology and scientific progress and development. Understanding and using science concepts in daily life problems and simple technology are goals in science education (Rusilowati et al., 2016). Law Number 20 of 2003 concerning the National Education System, Article 1 number 1 states that education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious, spiritual strength, self-control, personality, intelligence, noble character and skills needed by themselves, society, nation and state (Permendikbud, 2016).

Science and technology are influential in education in Indonesia. Developments that occur in technology will change the progress of the development of science. The more technology changes, the more education changes for the better. The educational process has undergone changes and developments in several areas of curriculum, learning methods, and facilities to support learning activities. Educational technology is already considered developed and significant. Therefore, the development of educational technology must be carried out so that it can cover all aspects of education and can be applied to the learning system (Sujana & Zainab Mukarroma, 2017).

Books are the dominant instructional media in the learning process. The existence of books has a central role in learning science, including in the learning process (Komalasari, 2017). The condition experienced by the Indonesian nation today is that there are not many human resources who can follow the path of technological progress appropriately and optimally. At times like this, this ability is needed to compete in determining quality human resources, competent, and able to compete globally both in terms of thoughts, expertise, and skills. Textbooks have tremendous power to change students' brains. Therefore, textbooks can influence individual knowledge and values (Rosmaini, 2013).

Literacy is the foundation of a person's ability to master science, communicate science, and be able to apply scientific knowledge to solve problems so that they have high responsiveness to themselves and the environment. PISA (Programme for International Student Assessment) is a literacy study organized by the Organization for Economic Co-Operation and Development (OECD) and the Unesco Institute for Statistics. It aims to analyze students' literacy skills periodically to determine the development of students' science literacy (Cristina et al., 2016).

Science literacy is very important for every individual to master because it is closely related to a person's ability to understand and examine the environment around him and the problems faced by modern society, which is very dependent on the development of science and technology, including social problems. So that the ability of science literacy is needed by every individual to understand science and technology that continues to grow. One of the steps to form individuals who have good and correct science literacy skills is through education, especially in science learning. Through the mastery of science literacy, it is expected that students in Indonesia will be able to master science and technology that is very useful for themselves, society, and the progress of the nation more broadly. There are practical ways to foster science and technology literacy. The main issues are workforce development, efficient curriculum design, and distance learning programs (Ojimba, 2013).

Based on the results of the PISA science literacy study in 2018 show that the ability of Indonesian students to compete at the international level still needs improvement. Indonesia ranks low among other participating countries. In the Science category, Indonesia scored 396, far below the average OECD score of 489, and ranked ninth from the bottom, followed by 71 countries (Avvisati et al., 2019). Science education needs to be effective and relevant for the majority of the population as well as for different groups (Fatonah Siti & Prasetyo Zuhdan K, 2014).

Previous research that examines the analysis of biology textbooks, namely (Huryah et al., 2017) in her research entitled "*Analisis Komponen Literasi Sains Pada Buku Teks Biologi Kelas XII*". This type of research uses a descriptive qualitative approach and states that science as a torso has a fairly large percentage, namely 65.75%. Research conducted by (Ginting, 2018) in his research entitled "*Analisis Tingkat Literasi Sains Buku Teks Biologi Kelas XII Pada Materi Sistem Saraf di SMA Se-Kecamatan Pancurbatu Tahun Pembelajaran 2016/2017*". The results obtained are the level of science indicators as a body of knowledge has a fairly high percentage of 77.20% Research conducted by (Pujiyanti et al., 2022) in her research entitled "*Analisis Komponen Literasi Sains Pada Buku Teks Biologi Kelas XI Sistem Peredaran Darah"*. The results obtained are the level of science indicators as a body of knowledge has a fairly high percentage of 65.75%. Research conducted by (Aulia A, 2014) in her research entitled "*Analisis Buku Teks Biologi SMA Kota Bandung Berdasarkan Hakikat Sains*". The results obtained are the level of science indicators as a body of knowledge has a fairly high percentage of 67%. Research conducted by (Nisaa et al., 2015) in his research entitled "*Analisis Buku Biologi Kelas XII Berdasarkan Muatan Literasi Sains*". The results obtained are the level of science indicators as a

body of knowledge has a fairly high percentage of 83.6%.

In the previous study, the dominant result obtained from his research was that the indicator of science as a body of knowledge had a large enough percentage. In this study, there is one aspect that is quite different because, in the indicator of the interaction of science, technology, and society, there is not a single indicator that appears in the four books analyzed, which needs to be examined to avoid things like this happening.

Based on the problems mentioned, this study aims to analyze the biology textbook of SMA class XII to improve the quality of science literacy and education in Indonesia. The aspects analyzed are science as a body of knowledge, science as the nature of inquiry, science as a way of thinking, and the interaction of science, technology, and society. This study used high school biology textbooks for grade XII in Medan City. The results of the analysis are expected to improve the quality of biology textbooks to improve and improve the quality of literacy that can be used as teaching materials.

## METHOD

The research used is to use qualitative research with a library research approach (Sugiyono, 2016). Descriptive research is research that is intended to investigate circumstances, conditions, or other things that have been mentioned, the results of which are presented in the form of a research report (Arikunto, 2014). The analysis is used by reading and understanding the text elements on the chapter pages of the analyzed book and matching them with the science literacy indicators based on the guidelines from (Chiappetta & Koballa, 2015), namely science as a body of knowledge, science as the nature of the inquiry, science as a way of thinking and the interaction of science, technology, and society.

The data source is the subject from which data can be obtained (Arikunto, 2014). Primary data sources were obtained through direct surveys of four schools in Medan City, namely SMA Swasta Al – Ulum, SMA Swasta Nurul Islam Indonesia, SMA Negeri 6 Medan, dan SMA Negeri 21 Medan where there are four books used in Medan City and used the 2013 curriculum namely Biology Book SMA / MA Class XII Author Elis Djubaedah, Publisher Grafindo; Biology Book SMA Class XII Author Manickam Bala, Publisher Grafindo; Biology Book SMA / MA Class XII Author Irnaningtyas, Publisher Erlangga, and Biology Book SMA / MA Class XII Author D. A Pratiwi, Publisher Erlangga.A Pratiwi, Erlangga Publisher. Secondary data were obtained through the

internet on the school data page.

The instrument used was adopted from (Chiappetta & Koballa, 2015) science literacy observation sheet with indicators, namely science as a body of knowledge, science as the nature of the inquiry, science as a way of thinking, and the interaction of science, technology, and society.

The data collection method used in this research is using the documentation method. While the data analysis used uses content analysis, which is a technique for collecting and analyzing the contents of a text (Moleong, 2018). Content analysis is carried out with several stages, namely reading and understanding the contents of the book under study, recording the science literacy categories contained in the contents of the book observed on each page, and compiling the results of observing the contents of the book regarding the science literacy indicators contained in the book under study on the science literacy observation sheet with indicators, namely science as a body of knowledge, science as the nature of the inquiry, science as a way of thinking and the interaction of science, technology, and society (Nazir & Sikmumbang, 2014).

## FINDINGS AND DISCUSSION

### Findings

The research data obtained includes the number of indicators and the percentage of each indicator of science literacy contained in four high school biology textbooks grade XII curriculum 2013. The chapter studied is chapter 7 on Evolution. The indicators used are based on guidelines from (Chiappetta & Koballa, 2015).

**Table 1.** Indicator of Science Literacy Contained in Four High School Biology Textbooks

| No. | Indicator |
|---|---|
| 1. | **Sains Sebagai Batang Tubuh Pengetahuan** |
| | 1. Menyajikan Fakta |
| | 2. Menyajikan Konsep |
| | 3. Menyajikan Prinsip |
| | 4. Menyajikan Hukum |
| | 5. Menyajikan Hipotesis |
| | 6. Menyajikan Teori |
| | 7. Menyajikan Model |
| | 8. Meminta siswa mengingat kembali pengetahuan |
| 2. | **Sains Sebagai Hakikat Penyelidikan Sains** |
| | 1. Mengharuskan siswa untuk menjawab pertanyaan melalui penggunaan materi |
| | 2. Mengharuskan siswa untuk menjawab pertanyaan melalui penggunaan grafik, tabel, dan lain – lain |
| | 3. Mengahruskan siswa untuk membuat perhitungan |
| | 4. Meminta peserta didik untuk menjelaskan terhadap jawabannya |
| | 5. Melibatkan peserta didik dengan eksperimen atau aktifitas berfikir |

| | |
|---|---|
| 3. | **Sains Sebagai Cara Berpikir** |
| | 1. Menggambarkan bagaimana seorang ilmuan melakukan eksperimen |
| | 2. Menujukkan sejarah pengembangan ide |
| | 3. Menekankan sifat empiris dan obejektifitas ilmu sains |
| | 4. Mengilustrasikan menggunakan asumsi |
| | 5. Menunjukkan bagaimana ilmu sains berjalan dengan induktif dan deduktif |
| | 6. Memberikan hubungan sebab akibat |
| | 7. Mendiskusikan fakta dan bukti |
| | 8. Menyajikan metode ilmiah dan pemecahan masalah |
| 4. | **Interaksi Sains, Teknologi dan Masyarakat** |
| | 1. Mendeskripsikan kegunaan sains dan teknologi dalam masyarakat |
| | 2. Menekankan efek negative dari sains dan teknologi bagi masyarakat |
| | 3. Mendiskusikan isu sosial yang berkaitan dengan sains dan teknologi |
| | 4. Menunjukkan pekerjaan – pekerjaan dalam bidang sains dan teknologi |

Every page of the book was analyzed, except for pages containing end-of-chapter questions and the inclusion of learning objectives. Each book has a different indicator level.

The following are the results of the data on science literacy aspects for each indicator in the high school biology textbook class XII curriculum 2013

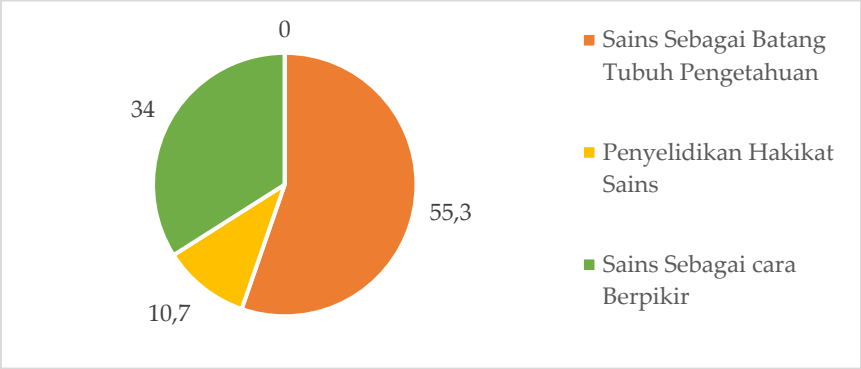
**Table 2.** Number and Percentage of Occurrence of Science Literacy Indicators

| No. | Indicator | Books | | | | | | | | Average ( % ) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SMA NII | % | SMA 6 | % | SMA 21 | % | SMA Al Ulum | % | |
| 1. | Sains sebagai Batang Tubuh Pengetahuan | 28 | 55 | 29 | 53 | 33 | 55 | 29 | 59,2 | 55,3 |
| 2. | Penyelidikan Hakikat Sains | 3 | 5,8 | 8 | 14,5 | 10 | 17 | 2 | 4,8 | 10,7 |
| 3. | Sains Sebagai Cara Berpikir | 20 | 39,2 | 18 | 32,7 | 17 | 28,3 | 18 | 36 | 34 |
| 4. | Interaksi Sains,Teknologi,dan Masyarakat | - | - | - | - | - | - | - | | - |
| | Total | 51 | 100 | 55 | 100 | 60 | 100 | 49 | 100 | 100 |

Based on Table 2, it can be seen that each book has a diverse number and percentage. And there are aspects of the interaction of science, technology, and society that are not owned by each book. Overall, each book has strength in the same indicator, namely the indicator of science as a body of knowledge with a fairly high percentage of 55.3%. Followed by science as a way of thinking with a percentage of 34%, then investigating the nature of science with a total percentage of 10.7%, and no percentage on the indicator of the interaction of science, technology, and society. Even so,

each book has the task of fixing the shortcomings of other indicators to avoid misconceptions in students when studying the book, especially in the indicator of the interaction of science, technology, and society, which does not have any indicators in each book. Because the four indicators of science literacy are interrelated, one of the indicators, if it cannot be fulfilled, allows misconceptions that can be experienced by students when learning using the book, which can have an impact on the quality of their knowledge. This can also be a view to improve and refine teaching materials such as books so that they can have better quality content of science literacy. Here's to better understand the emergence of science literacy indicators in the four books in the figure below.

**Figure 1.** Occurrence of Science Literacy Categories in Each Book




Based on Figure 1 above, the dominant percentage is in the Science as a Body of Knowledge category, with the most occurrence among the other three categories amounting to 55.3%. Followed by science as a way of thinking with a percentage of 34%, then the investigation of the nature of science has a percentage of 10.7%. Meanwhile, the interaction of science, technology, and society has the least value and amount of 0% because there is no single indicator in the book under study. Although science as a body of knowledge has a large enough percentage, there are some aspects in the indicator of science as a body of knowledge that are still empty. And the value is covered by several aspects that have a large enough number to cover the vacancies of other aspects. The following is an assessment of the content of each indicator in each book.

**Table 3.** Indicators of Science Literacy Aspects of Science as a Body of Knowledge

| No. | Indicator | Books | | | | ∑ | % |
|---|---|---|---|---|---|---|---|
| | | SMA NII | SMA 6 | SMA 21 | SMA Al Ulum | | |
| 1. | Menyajikan fakta - fakta | 10 | 10 | 11 | 12 | 43 | **36,4** |
| 2. | Menyajikan konsep - konsep | 6 | 2 | 6 | 3 | 17 | **14,4** |
| 3. | Menyajikan prinsip – prinsip | 1 | 1 | 1 | 1 | 4 | **3,3** |
| 4. | Menyajikan hukum | 1 | 1 | 1 | 1 | 4 | **3,3** |
| 5. | Menyajikan hipotesis – hipotesis | - | - | 1 | - | 1 | **0,8** |
| 6. | Menyajikan teori – teori | 2 | 6 | 4 | 6 | 18 | **15,2** |
| 7. | Menyajikan model – model | 8 | 8 | 9 | 6 | 31 | **26,6** |
| 8. | Meminta siswa untuk mengingat pengetahuan kembali | - | - | - | - | - | **-** |
| | Total | 28 | 28 | 33 | 29 | 118 | **100** |

In Table 3, each of the books studied has a different amount, and there is also the same amount. The indicator of presenting facts has a greater number of occurrences, with a value of 36.4%, and the highest number of occurrences of the indicator of presenting facts is found in the SMA AlUlum book, with a total of 12 statements contained in the book. Each book does not have any indicators in asking students to recall knowledge, and this is as important as other indicators because it is useful for evaluating students to recall what has been learned. In one indicator, it shows that the book owned by SMA 21 Medan has the advantage of having an indicator for presenting a hypothesis which makes this book slightly different from other books that do not have this indicator. Although it only has 1 statement contained in the book, this is enough to make a difference to several other books. Things like this should be maintained and developed to create good insights for students through textbooks in terms of science literacy.

**Table 4.** Indicators of Science Literacy in the Aspect of Science as a Nature of Inquiry

| No. | Indicator | Books | | | | ∑ | % |
|---|---|---|---|---|---|---|---|
| | | SMA NII | SMA 6 | SMA 21 | SMA Al Ulum | | |
| 1. | Mengharuskan siswa untuk menjawab pertanyaan melalui penggunaan materi | - | 6 | 6 | - | 12 | **52,1** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2. | Mengharuskan siswa untuk menjawab pertanyaan melalui penggunaan grafik, tabel, dan lain – lain | - | - | - | - | - | **-** |
| 3. | Mengahruskan siswa untuk membuat perhitungan | 2 | 1 | - | - | 3 | **13,2** |
| 4. | Meminta peserta didik untuk menjelaskan terhadap jawabannya | - | - | 1 | - | 1 | **4,3** |
| 5. | Melibatkan peserta didik dengan eksperimen atau aktifitas berpikir | 1 | 1 | 3 | 2 | 7 | **30,4** |
| | Total | 3 | 8 | 10 | 2 | 23 | **100** |

In Table 4, it can be illustrated that each book has a small number or even no one of the indicators. Among the four books, the SMA 21 Medan book has the highest total number of statements, followed by SMA 6 with a total of 10 and 8 statements, respectively. The other two have quite low numbers, namely in the SMA NII and SMA Al Ulum books, with a total of 3 and 2 statements in each aspect. This makes both of them have a very low value of the indicator of science as the nature of inquiry. And the four books both have no value, namely the indicator of expecting students to answer questions through the use of graphs, tables, and others. Only one indicator stands out, namely the indicator that requires students to answer to answer questions through the use of materials. And in the 5th indicator, namely involving students with experiments or thinking activities, each book has this indicator, and most are in the SMA 21 Medan book. To implement students have good science literacy, the book should be able to have good science literacy indicators as well by paying attention to each science literacy indicator contained in the textbook.

**Table 5.** Indicators of Science Literacy Aspects of Science as a way of thinking

| No. | Indicator | Books | | | | Σ | % |
|---|---|---|---|---|---|---|---|
| | | SMA NII | SMA 6 | SMA 21 | SMA Al Ulum | | |
| 1. | Menggambarkan bagaimana seorang ilmuan melakukan eksperimen | 5 | 9 | 4 | 5 | 23 | **31,5** |
| 2. | Menujukkan sejarah pengembangan ide | 13 | 9 | 12 | 9 | 43 | **59** |
| 3. | Menekankan sifat empiris dan obejektifitas ilmu sains | - | - | - | - | - | **-** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4. | Mengilustrasikan menggunakan asumsi | - | - | - | - | - | **-** |
| 5. | Menunjukkan bagaimana ilmu sains berjalan dengan induktif dan deduktif | - | - | - | - | - | **-** |
| 6. | Memberikan hubungan sebab akibat | 2 | - | 1 | 4 | 7 | **9,5** |
| 7. | Mendiskusikan fakta dan bukti | - | - | - | - | - | **-** |
| 8. | Menyajikan metode ilmiah dan pemecahan masalah | - | - | - | - | - | **-** |
| | Total | 20 | 18 | 17 | 18 | 73 | **100** |

Based on Table 5, it can be seen that the four books have shortcomings in several indicators, namely emphasizing the empirical nature and objectivity of science, illustrating using assumptions, showing how science works inductively and deductively, discussing facts and evidence, and presenting scientific methods and problem-solving. However, in the indicator of showing the history of the development of ideas, each book has a lot of numbers obtained, especially in two books, namely SMA NII and SMA 21 Medan books. The second indicator, showing the history of the development of ideas, has a large enough percentage of 59%, followed by an indicator describing how a scientist experiments at 31.5%, and then there is an indicator providing a causal relationship of 9.5%. Apart from these indicators, the four books do not have these indicators. From the results above, the indicator of the history of the development of ideas is the most prominent and is quite common in the four books. In this indicator, it appears that each book on the aspect of showing the history of the development of ideas covers the shortcomings of other aspects by having a considerable amount. However, the book must balance the value of other indicators to fulfill other aspects so that the quality of the book in science literacy becomes better.

**Table 6.** Indicator of Science Literacy Aspects Interaction of Science, Technology, and Society

| **No.** | **Indicator** | **Books** | | | | ∑ | % |
|---|---|---|---|---|---|---|---|
| | | SMA NII | SMA 6 | SMA 21 | SMA Al Ulum | | |
| 1. | Mendeskripsikan kegunaan sains dan teknologi dalam masyarakat | - | - | - | - | - | - |
| 2. | Menekankan efek negative dari sains dan teknologi bagi masyarakat | - | - | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3. | Mendiskusikan isu sosial yang berkaitan dengan sains dan teknologi | - | - | - | - | - | - |
| 4. | Menunjukkan pekerjaan – pekerjaan dalam bidang sains dan teknologi | - | - | - | - | - | - |
| | Total | - | - | - | - | - | - |

Table 6 shows one of the science literacy categories that cannot be fulfilled in the four biology textbooks. There is no presence of each category in each of these books. This can create misconceptions for students because they do not know one of the science literacy indicators that should be in the textbook. Because of this, each book needs to make improvements and changes to meet science literacy in the book and immediately take further action so that things like this can be gradually minimized in the future can be avoided. Not only one indicator but every other indicator some are still lacking and even have no value at all.

**Discussion**

The overall average percentage of science literacy results from the four biology textbooks analyzed shows the indicator of science as a body of knowledge, which is 55.3%. This is in line with the results of research from (Huryah et al., 2017), which shows the indicator of science as a body of knowledge has the most occurrence value among the other three indicators in the textbooks analyzed. The second highest occurrence is the indicator of science as a way of thinking which has an occurrence of 34%. Furthermore, the indicator of science as an investigation of the nature of science has an appearance of 10.7%. And the last is the indicator of the interaction of science, technology, and society, which has no appearance at all in each book. This shows that the indicator of the interaction of science, technology, and society has the lowest percentage of 0%, with no occurrence.

This data is also by research conducted by (Ariningrum, 2013), who analyzed the content material in four high school biology textbooks with the results of the study that the dominating category was an indicator of science as a body of knowledge. Research conducted by (Udeani, 2015) has differences from the current study, namely because the book analyzed has a dominant indicator of science as a way of thinking. This makes the book emphasize the thinking aspect for students in learning.

Although all aspects of literacy have been analyzed in each book, the results of the analysis do not show a balance in science literacy indicators. Each book has its dominant indicators. And

forget some indicators that should be in the textbook. This can lead to a lack of quality science literacy that students receive in learning through textbooks. This kind of factor is one of the factors in the low science literacy of a student and the low score of Indonesia's science literacy in the PISA program. This is by (Wahyu et al., 2016) that science process skills are skills needed to become or work as a scientist. Mastery of knowledge of each category of science literacy is necessary for the development of students' literacy process skills.

However, in this study, one indicator did not have a value or number at all in the science, technology, and social interaction indicator. This is a concern for all four books because the loss of one indicator may be a misconception in students during learning and will have an impact on personal needs, work, and participation in society. According to (Cristina et al., 2016), along with the increasingly dominant role of science in everyday life, the ability to read, write and calculate is not enough. Science literacy is needed to meet personal needs, work, and participation in society. Each factor of the science literacy indicator is very useful for students in involving them in answering, calculating, analyzing, and doing a practicum or hands-on will make learners able to support and connect the link between the science material learned based on their own experience (Kurniasih, 2014). This shows that the indicator of science as the nature of inquiry and science as a way of thinking has a considerable role, but the four books still do not fulfill some aspects contained in the two indicators, which can be something that must be addressed in the four books. Science literacy will not be achieved if there is no good and correct learning. Books that can develop scientific literacy are books that can make and increase the intelligence of an individual (Anjarsari, 2014).

Based on this, these four books still need emphasis and changes in presenting the four aspects of science literacy. Emphasizing all aspects of science literacy will be able to prepare the potential of a science-sensitive society for the advancement of a nation that is more suitable for rapid global change (Cansiz & Turker, 2015). Science literacy has a very good role and importance when it can be understood (Hilmi et al., 2015) stated. Science literacy is a multidimensional ability that learners must have. These abilities include knowledge, skills, dispositions, a good relationship between science and technology - society, and the history and nature of science.

## CONCLUSION

Of the four XII grade high school biology textbooks that have been analyzed based on science literacy, the results of science literacy are as follows: (1) science as a body of knowledge by 55.3%,

(2) science as an investigation of the nature of science by 10.7%, (3) science as a way of thinking by 34%, (4) the interaction of science, technology, and society by 0%. The results showed that the four grade XII high school biology textbooks used in Medan City had a scope on the aspect of science as a body of knowledge and minimally presented the interaction of science, technology, and society. Overall, the books have covered the good category in science literacy.

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