



Representation of Aspects of Science Process Skills in the High School Biology Textbook Ecosystem Materials

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Abstract

Background: Science Process Skills (SPS) is a skill that facilitates students to find realities, decide on ideas and apply theory to daily existence. Textbooks in North Sumatra are assorted, and the availability of SPS aspects is not widely known. This study aims to determine the availability of SPS aspects in the most widely used high school textbooks in senior high school in one of city in North Sumatra. **Methods:** This study used content analysis research. The samples were purposive sampling using the most widely used books in state high schools in Binjai City. The data analysis technique in this study includes quantitative and qualitative. Qualitative data analysis was carried out by identifying the emergence of SPS aspects in the analyzed textbooks. Meanwhile, quantitative data analysis is carried out by calculating the frequency and Percentage of occurrences of SPS aspects in biology textbooks. **Results:** The results showed that the high school biology textbook class 10 was appropriate in providing aspects of science process skills in Ecosystem material. Book A provides 80% of all aspects of science process skills and book B provides 60% of all aspects of observed science process skills. **Conclusions:** of this study can be used as a reference for teachers in choosing textbooks that will be used as learning resources in facilitating SPS. Furthermore, continuous efforts are needed from the government,

Keywords: Biology Textbooks; Content Analysis; Science Process Skills

Introduction

The teaching and learning process of science, especially biology, emphasizes the expertise of students in compiling a process because biology is generally understood as a science developed through the stages of observation (observation), finding problems, forming hypotheses, testing speculation through tests, making conclusions, and innovating concepts and theories (Pratama et al., 2011). Biology learning aims to develop student competencies centered on direct experience in exploring and scientifically understanding the surrounding natural environment (Venville & Treagust, 1997). Learning Biology in the 21st century requires creative thinking, critical thinking, communication, and collaboration skills called 21st-century skills, and the educational concept is more famous as 21st-century learning (Ardelia & Juanengsih, 2021). Biology learning does not emphasize learners learning about products but also all aspects of processes, behaviors, and technologies so that students truly understand science fully and the characteristics of science as a whole, especially biology (Astuti et al., 2015). Therefore, the right approach is needed in learning biology, one of which is the Science Process Skills (KPS) approach.



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Science Process Skills (KPS) in Özgelen, (2012) research defines KPS as the scientific method, scientific thinking, as well as critical thinking. Based on other sources, science process skills are specific skills that simplify the science of learning, allowing learners to cultivate a sense of responsibility of learners in learning, improve learning provisions, and teach them research methods (Karamustafaoğlu, 2011). Aspects developed include scientific methodologies (Scientific Approach) such as observation, trial, processing, presentation, and reasoning ability (Asih, 2015). Through scientific activities, KPS helps learners discover theories and concepts (Ongowo & Indoshi, 2013). Thus, KPS is considered important in the learning process of biology to dominate knowledge and objectives that are important at the science level (Ratnasari et al., 2017).

Science Process Skills (KPS) are divided into two, namely Basic KPS and Integrated KPS (Lederman et al., 1993). Basic KPS consists of observation, summarization, measurement, prediction, how to communicate, classifying, using space and time, and using numbers. Meanwhile, Integrated KPS consists of identifying variables, forming data tables, forming graphs, how to describe the relationships between variables, how to obtain and to process data, how to study examinations, building hypotheses, measuring variations operationally, and designing investigations, and how experiments (Turiman et al., 2012). If students can fully master the Basic KPS, they can master the abstract thinking contained in the KPS (Piaget, 1964). his approach is more indicative of the cycle of the pursuit of information science as opposed to the transfer of information, students are required to be actively involved in the learning process, and the role of the teacher is only as a provider of facilities such as guiding and coordinating the learning activities of students (Haryono, 2006).

Just like the KPS approach, there are other approaches such as the Science of Process Approach (S-APA) which is a learning approach oriented to the scientific process. But in its purpose and implementation, there are differences. S-APA does not attach importance to the concept and demands the development of a complete process approach, namely the scientific method in each implementation, while the types of process skills in the KPS approach can be developed separately, depending on the method used (Rustaman, 2007). The KPS approach is more towards the skillful development of learners in processing their knowledge with the aim that students can know about the facts, concepts, and values needed (Karsli & Şahin, 2009). Therefore, students will be educated, trained and proficient in obtaining data using the scientific method (Antrakusuma et al., 2017). The KPS procedure, namely using adequate means in the form of documents such as textbooks that contain ideas of facts as a science product and have been utilized by experts (Irez, 2016).

Reading materials are reference books that must be used in schools, compiled according to the national standard educational mechanism, including learning materials to increase trust and piety, ethics, accuracy in mastering science and technology, sensitivity and aesthetic abilities, physical abilities and health (Rosmilan, 2020). In addition, textbooks become a reference for learning assets because they are clearly presented and arranged systematically, including demonstrating techniques and means for educators, containing knowledge from the first to assignments and preparations, and presenting material resources for conducting assessment or remedial evaluations (Ramadhani et al., 2019). Therefore, the textbook must meet the standards of the criteria of the textbook of the lesson from the components of the book cover, the beginning, the content section to the last (Ulumudin et al., 2017).

Textbooks are one of the teaching materials that are strategically positioned and affect the quality of education, because they can function as learning resources and learning media that are very important for achieving competence in learning objectives (Sicilia et al., 2016). Ecosystem material is one of the materials related to nature that can be observed through the surrounding environment (Aulia, 2018). One of the supports for the learning process to explore the surrounding environment is the use of textbooks. The increase in student activity is difficult to occur by itself. Therefore, the role of the teacher is indispensable in creating a learning process situation full of student activity with one of

them using textbooks (Munafi'ah, 2021).

One of the criteria for a good textbook is one that can facilitate KPS. Textbooks that can facilitate KPS are textbooks that contain scientific approaches as recommended in the curriculum. Textbooks can be said to be the main learning resource because textbooks have several functions such as being a source of student learning, as a guide to direct the activities of students and teachers in the continuity of the learning process (Ramadhani et al., 2019). Textbooks containing KPS aspects are one of the things that can improve students' ability to work scientifically as expected by the curriculum (Shofia & Ngurah, 2019). Biology books that develop science process skills also play a role in developing a higher understanding of concepts and thinking abilities. This is because students are required to apply the scientific method during learning, so they are expected to develop science, gain new knowledge, and develop the knowledge they already have (Fauziyah & Eko, 2022).

After conducting interviews on biology teachers at several state high schools in one of the cities in North Sumatra, data were obtained that teachers used more textbook learning resources and sub-materials that were considered to require a KPS approach, namely ecosystem materials and environmental pollution materials. The concept of ecosystem itself includes various components such as biotic and abiotic components, interactions between organisms and the environment, energy cycles and so on that can be observed directly in the surrounding environment so that a KPS approach is needed which is presented in textbooks which can then explore students' potential in asking, doing activities, finding and collecting data, and making their own conclusions (Colley, 2006). Thus, in textbooks on the biology of ecosystem materials require analysis regarding the representation of KPS aspects.

Research that examines aspects of KPS in textbooks has been conducted by Ramadhani et al., (2019). However, the textbooks studied are physics textbooks. The research of Antrakusuma et al., (2017) where analyzing the KPS aspects of chemistry books. There has not been much research that examines biology textbooks from the aspect of KPS. Research related to the analysis of biology textbooks was carried out by Marianingsih (2021) where researchers investigated aspects of environmental literacy in biology textbooks, Pathiyah (2019) investigated the level of accuracy of bilingual biology book ideas, as well as Fajriana et al., (2016) which conducted research related to biology textbook misconceptions. This can open up opportunities to conduct biology textbook analysis on other variables such as Science Process Skills.

From the presentation of the background of the problem, the researcher conducted further research to analyze biology textbooks in terms of the availability of KPS aspects which aimed to find out the representation of KPS aspects contained in textbooks. The results of this study are expected to provide information related to learning resources that facilitate aspects of the Science Process Skills of students to meet the characteristics of biology learning according to the demands of curriculum requirement.

Methods

This research uses a content analysis research design (content study) with research procedures, namely determining the problem to be analyzed, choosing the object of research, determining the formula to be used, sampling, and analyzing data (Ary et al., 2010). The sample used in this study was a high school biology book, selected using a purposive sampling technique using a textbook sample that was commonly used by several high schools in one of the cities in North Sumatra. This research focuses on ecosystem materials, where the presentation of elements of science process skills is identified and analyzed. The analyzed books can be seen in Table 1.

Table 1. Book Identity

No	Title	Curriculum	Publisher
1	Biologi untuk Siswa SMA Kelas X	2013 Revisi	Yrama Widya
2	Aktif dan Kreatif Belajar Biologi untuk SMA/MA kelas X	2013 Revisi	Grafindo Media Pratama

The instruments used in this study are interview alloy sheets related to the use of textbooks in schools and materials that require KPS aspects, namely ecosystems, and analysis sheets related to the availability of KPS aspects in high school biology textbooks used that have been validated by professional academics in the field of biology. The analysis sheet contains a table for writing down the KPS indicators that appear on the textbook. Technical data analysis is carried out quantitatively and qualitatively. Qualitative data analysis is carried out by identifying the emergence of aspects of KPS in the analyzed textbook. Meanwhile, quantitative data analysis is carried out by calculating the frequency and Percentage of the appearance of KPS aspects in biology textbooks. KPS elements used in analyzing books based by [Rustaman \(2007\)](#), include observation (observation), classification, interpretation, prediction, questioning, hypothesizing, investigating, using tools and materials, applying concepts, as well as communicating. The methods taken in data analysis are as follows:

1. Determine what you want to analyze and sort out important factors in the form of statements in the form of paragraphs, images, or tables.
2. Code the book where the book published by Grafindo (Book A) and the book published by Yrama Widya (Book B)
3. Conducting an analysis based on the elements of KPS [Rustaman \(2007\)](#) namely observation, classification, interplay, prediction, questioning, hypothesizing, conducting investigations, using tools and materials, applying concepts, and communicating.
4. Fill out the analysis sheet based on the data obtained
5. Calculating the Percentage of occurrence of KPS aspects in high school biology textbooks chapter ecosystem materials using the following formula:

$$\frac{\sum \text{Emerging KPS componentet}}{\text{total } \sum \text{KPS Components that appear}} \times 100 \%$$

6. Determining the category of conformity by category adapted [Wilkinson \(1999\)](#) is presented in the following table:

Table 2. Conformity Categories

Percentage	Category
<40%	Not Appropriate
40%-75%	Appropriate
>75%	Very Appropriate

7. Determine Reliability

To avoid the subjectivity of observers, the reliability of observations must be carried out in descriptive research ([Budhiastuti, 2018](#)). The realibility of the observer must be carried out by other observers (outside the researcher). An observer conducted the research with the aim of making the results more objective ([Retnawati, 2016](#)). his research instrument is obtained from an analysis sheet that has been prepared and filled out by the researcher (as an observer I) and through the re-analysis stage by observer II and observer III (expert lecturer). This is done to find out and decide the final result between observers and observations that have been made. The results of the observer agreement on book A (Grafindo) were 96% and for book B (Yrama Widya) it was 93%. The results of this agreement are used as a reference to continue at the stage of presenting data and analysis narratively.

8. Make conclusions based on the data presented in the form of narrative texts.

Result

The availability of KPS aspects in each of these books is not the same, and not all aspects of KPS arise in the two books analyzed. The data from the analysis obtained the frequency and Percentage of the level of occurrence of KPS that appeared in the statements and activities in the high school biology textbook ecosystem material. The appearance of the KPS aspect on both books is presented in the form of tables and diagrams. Based on the analysis of the availability of KPS aspects, the frequency of the emergence of KPS aspects in two ecosystem material biology textbooks that are in great demand in two state high schools in one of the cities in North Sumatra (Table 3).

Table 3. The emergence of KPS aspects in the chapter Ecosystem Materials

No	KPS Aspect	Sample Book A	Sample Book B
1	Observe	3	3
2	Classifying	2	0
3	Interpreting	1	2
4	Predict	3	1
5	Questioning	0	0
6	Creating a Hypothesis	0	0
7	Investigate	1	1
8	Using Tools and Materials	2	2
9	Apply	1	0
10	Communicate	1	1

From Table 4 it is known that not all aspects of KPS appear in every book analyzed. There are several frequencies of the appearance of the same KPS aspect in both books, namely in the aspects of observing, investigating, using tools and materials, and communicating. The emergence of the KPS aspect classifies, predicts, and applies to book A more than book B and the emergence of the KPS aspect interprets in book B more than book A. The emergence of the KPS aspect questions it and makes hypotheses not found in both books. The frequency of appearance of the KPS aspect is then calculated on average Percentage to determine the suitability of the KPS aspect according to John Wilkinson's criteria with results of 80% for book A and 60% for book B.

The KPS aspect of each book is then recapitulated to see the KPS indicators which have a percentage of the level of occurrence of the KPS aspects that appear the most in high school biology books.

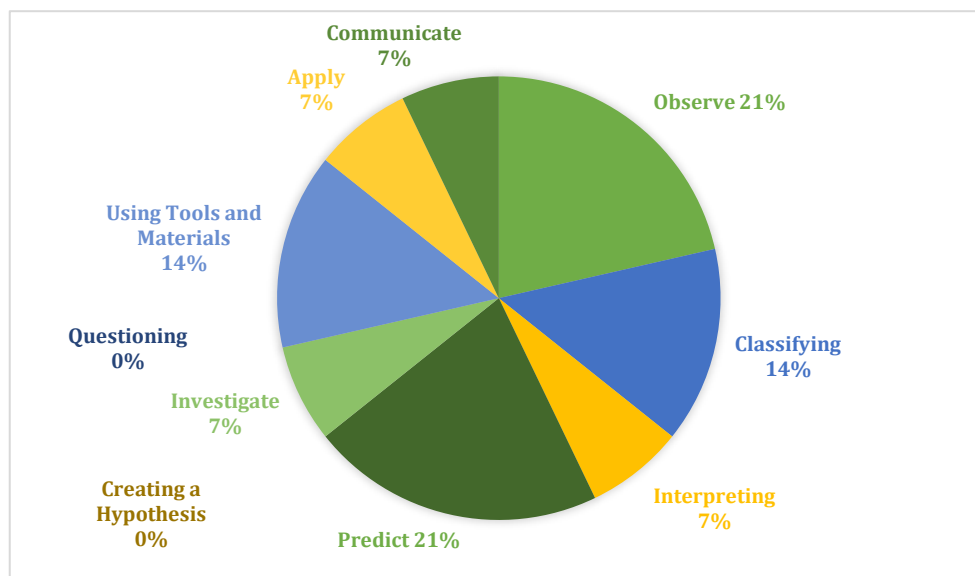


Figure 1. Percentage Diagram of Availability of KPS aspects in Book A

The summary of the results of the appearance of all aspects as shown in table 4 is then adjusted to the categories of PPP conformity presented in Table 5. The recapitulation based

on the results of the analysis of the availability of PPP aspects of Biology textbooks that are most widely used in two state high schools in one of the cities in North Sumatra on the Ecosystem material shows different data. There is the emergence of aspects of observing, classifying, interpreting predicting, investigating, using tools and materials, replicating, and communicating in book A and there is the emergence of aspects of observing, interpreting, predicting, investigating, utilizing tools and materials, and communicating in book B.

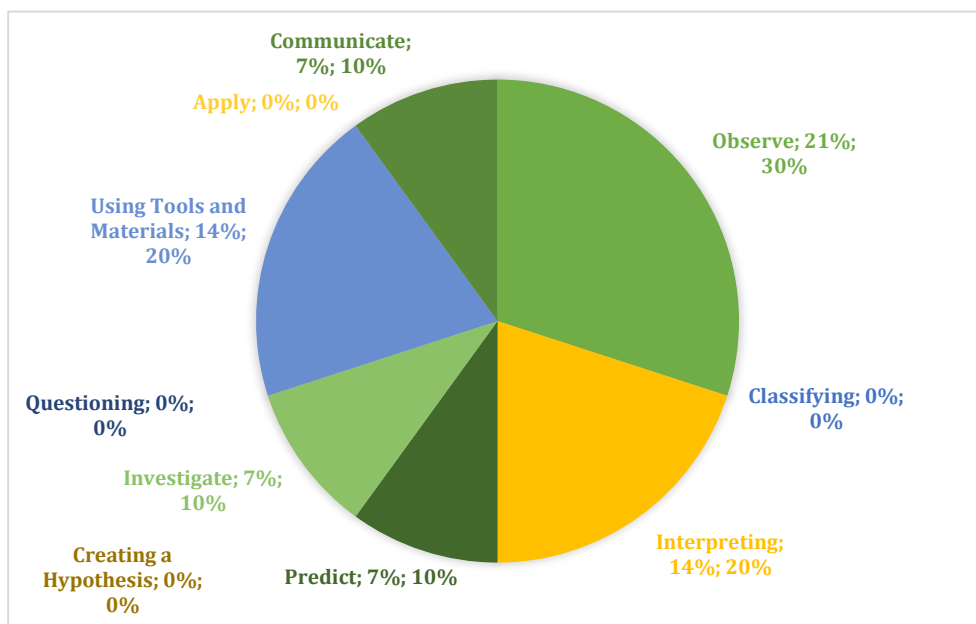


Figure 2. Percentage Diagram of Availability of PPP aspects in Book B

Table 5. Recapitulation of PPP Availability Percentages in Textbooks

No	Textbook Biology	Availability Level	
		Availability Percentage	Category
1	Book A	80%	Very Appropriate
2	Book B	60%	Appropriate

Discussion

The observing aspects in the analyzed biology textbooks are classified as facilitating (Figure 3). Observing skills are basic skills for learners (Dewi, 2008). The ability to observe in reading materials is filled with activities that use the senses. This is in accordance with the theory that the activity of using sensory tools is indeed used to obtain information to increase understanding of the information received (Rusmiyati & Yulianto, 2009). The high school Biology book of ecosystem materials distributed by Grafindo and Yrama Widya presents the same number of observing indicators. One example of the observing aspect of the two books is to observe the surrounding environment and biotic and abiotic components in the student activity section.

The aspect of classifying textbooks analyzed has a different presentation; in book A it presents an aspect of classifying and book B does not. Classification is a skill that is based on observing skills where the skill of classifying is beyond observation (Rustaman, 2005). The presentation of this classifying aspect is displayed to categorize phenomena or from real events such as practicums that can be observed directly. When carrying out the classification, observe in advance the characteristics of what will be classified (Dewi, 2008). The classifying aspect in book A is emphasized in student activities to classify living things in the ecosystem.

The interpreting aspect appears in book A and book B. Practicum activities more

dominate the presentation of the interpretation aspect in Biology textbooks because each practicum activity will get a conclusion. Students can practice the ability to interpret by observing clues to the object to be inferred (Alimah, 2012). This is in accordance with the definition of interpreting which is a skill to draw conclusions based on existing data (Murni et al., 2017). The interpreting aspect in book A is found in the student activity section where students are asked to make a chart of the energy flow of the ecosystem's components. The emergence of the interpreting aspect in book B is also found in the student activity section where students are asked for their opinions about the interaction between living things in the ecosystem.

The predicting aspect is also developed in both books. The presentation of the predictive aspect in the Biology textbooks analyzed is dominated by invitations for students to express an oddity that may occur in a situation that has not yet occurred. Predictive skills lead students in conveying conjectures about something that has not yet happened (Yuanita, 2018). This fits with the definition of predicting that predicting skills can make students understand the skills that students are asking to use design. The appearance of the predicting aspect in both books is found in the student activity section where students are led to predict something that will happen to another organism if there is an event such as the loss of one organism in the ecosystem.



Figure 3. Aspects of predicting in book A and book B

The questioning aspect is not presented in the two Biology textbooks analyzed. There are no student activities to stimulate students in asking questions. There is disagreement between observers II and observers I and III regarding this aspect. There should be questioning skills in textbooks based on activities or experiments carried out by students so as to stimulate students to actively ask many questions and be able to concentrate the observed object to be more directed (Rustaman, 2014). Students effectively ask questions and will get answers in overcoming curiosity and things that are not yet understood (Rusmiyati & Yulianto, 2009).

The hypothesis aspect is also not presented in book A and book B. There are no activities that lead students to hypothesize in both books. Hypothetical skills are able to combine previously acquired knowledge with the facts found to obtain solutions to the problem (Widoretno & Susilo, 2012). According to the results of research conducted by Prasojo in 2016, students' hypothetical skills are still recorded low because students have not been accustomed to hypothesizing in carrying out a practicum activity (Prasojo, 2016).

The investigative aspect is found in both books. The investigative aspect of book A includes instructions for students to find out a similarity in some of the phenomena that

occur. Investigating the surrounding nature that has to do with the material studied is obtained in book B. Investigative activities carried out by students will increase the level of thinking ability in the learners themselves (Wegasanti & Maulida, 2017). The emergence of the investigative aspect in book A is found in the student activity section where students are asked to investigate the similarities between habitats in accordance with observations about the ecosystem that have been carried out. The investigative aspect is also found in book B where students are asked to investigate the surrounding nature related to ecosystems.

Aspects of using tools and materials are presented in both books in the student activity section, namely practicum about the ecosystem. However, the presentation of skills using tools and materials is not facilitated because the presentation only instructs students to determine tools and materials without informing students in understanding the reasons and procedures for use in carrying out practicum activities. In fact, this skill is an important variable determining the progress of the experiment (Widayanto, 2009). This shows that textbooks must focus more on students in making preparations before conducting an experiment starting from determining tools and materials to knowing the naivety of the tools and materials used so that the experimental activities can take place properly.

Furthermore, the application aspect where this aspect is presented in book A but not presented in book B. The emergence of aspects of applying to book A is found in the student activity section where students are asked to do project tasks that can be applied to learning media. The aspect of applying to book A is presented after the textbook presents the theory, followed by a question related to the surrounding nature so that students can apply concepts in explaining the phenomena that occur. Students can implement the skill of applying after understanding the concept and explaining new events using the same concept (Yuanita, 2018).

The last aspect of PPP that appears in both textbooks is the aspect of communicating. Book A and book B present the communicating aspects contained in the student activity section where students are asked to present group work and discuss conclusions with the teacher. The textbook instructs students to present the experiment's results and make conclusions. Communication skills can make students helped in understanding accurate information so that students can understand the data obtained (Yusefni & Sriyati, 2016).

The reading material that the researcher uses as the object of research regarding the availability of PPP aspects can be declared appropriate or appropriate. However, there are some PPP aspect skills that do not exist and are not developed in the two books, namely the skills of the aspect of asking and hypothesizing. Research conducted by Hilpan in 2015 regarding the analysis of PPP aspects in physics textbooks also found no questioning aspects but there were aspects of making hypotheses (Hilpan, 2015). in line with Dewi's research Dewi (2019) which also found no aspect of asking physics textbooks. In fact, this skill is important to appear in textbooks so that it can develop the ability to think critically, communicate and add information in observation activities (Rusmiyati & Yulianto, 2009). For example, in the aspect of asking questions, several student activities can be provided in the textbook that can bring up the student's ability to ask questions and in the aspect of doing hypotheses can be provided in the textbook student activities that support students to guess exactly what will happen in the experiment based on pre-existing reference datau references (Rustaman, 2007). Therefore, it is necessary to continuously develop textbooks from the government to modify them so that they can be in accordance with the established aspects of ppp.

Learning biology or science will only be understood by students if students are actively involved intellectually, manually, and socially (Rustaman, 2007). The development of PPP in student learning resources is ideally developed if you have understood the nature of learning science, namely science as a product and process (Fitriani et al., 2016). Learning using the PPP approach allows students to learn concepts that are the purpose of learning science and at the same time develop basic science skills, scientific attitudes and critical attitudes (Safahi, et al., 2021).

The results of this study can be used as a reference by teachers in choosing biology textbooks as learning resources that facilitate the development of student PPP aspects. However, some aspects of PPP still have not been fulfilled or contained in the ecosystem material chapter in the analyzed book. Thus, alternative planning from teachers is needed in using learning approaches and media other than the use of textbooks to develop students' Science Process Skills.

Conclusions

Based on the results of the analysis carried out, it can be concluded that the most widely used high school biology textbooks in state high schools in one of the cities in North Sumatra are appropriate in terms of PPP availability. The elaboration of student materials and activities from book A contains aspects of observing, classifying, interpreting, predicting, investigating, using tools and materials, applying and communicating. The section of elaboration of student materials and activities in book B contains aspects of observing, interpreting, predicting, investigating, using tools and materials, and communicating. However, in the example of questions and student activities do not contain aspects of PPP. Therefore, it is necessary to develop biology textbooks on an ongoing basis that focus on the representation of PPP aspects in sample questions and exercises. Thus, examples of questions and exercises in textbooks not only measure students' understanding of the material, but also measure students' mastery of science process skills. The limitation of the problem in this study is the frequency and Percentage of availability of PPP aspects in the high school Biology textbook of ecosystem materials. Suggestions for related institutions or subsequent research are expected to conduct research on Biology books other than printed books such as electronic books and on a wider scope of material nationally which covers all textbooks used by several cities or provinces in Indonesia.

Declaration statement

The authors reported no potential conflict of interest

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