

THE VALIDITY OF BILINGUAL TEACHING MATERIAL BASED ON STSE ON FUNGI MATERIAL TO PRACTICE SCIENTIFIC LITERACY FOR SENIOR HIGH SCHOOL GRADE 10th

Dewi Purwasih

Biology Department, Faculty of Mathematics and Natural Science, State University of Surabaya
email: dewipurwasih16030204099@mhs.unesa.ac.id

Isnawati

Biology Department, Faculty of Mathematics and Natural Science, State University of Surabaya
email: isnawati@unesa.ac.id

Abstract

Teaching Materials are the teaching aids to explain concepts to students or evaluate their performance to increase the quality of learning, one of which is scientific literacy skills in the school. Teaching material based on STSE (science, technology, society, environment) can facilitate scientific literacy skills for students. Fungi material has to vary content related to science, technology, society, and the environment. The students can practice their scientific literacy skills. The research aimed to explain the theoretical eligibility of bilingual teaching material based on STSE on fungi material to practice scientific literacy for senior high school grade 10th. The theoretic eligibility is measured based on product validity. The research of development refers to the Model of Fenrich Instructional Development Cycle conceives phases such as analysis, planning, design, development, and implementation, in which every cycle must be evaluated and revised. The validity of the teaching material was assessed by a biology education expert, a fungi material expert, and a biology teacher of senior high school. The data were analyzed qualitatively. The developed teaching material was counted to be able to practice students' scientific literacy skills. Based on the validation result of three components are content 3.87, appearance 4, and linguistic 3.93. Based on the result of three criteria of theoretical eligibility acquired an average score of 3.93 with a percentage of 98% with a very valid category. Hence the teaching material was valid to use in the learning activity.

Keywords: STSE (Science, Technology, Society, Environment), Fungi, Scientific literacy, Teaching Material

INTRODUCTION

Fungi is one of the subjects that must be learned by high school students in grade 10th IPA in semester 1. The main subject of fungi contains the general characteristics of fungi, classification of fungi, how to get nutrition, and the role of fungi. Based on an interview with several biology teachers for grade 10th were got information that students believed fungi is one of the challenging subjects to study for some scientific names, sub-topic of the fungi material such as identification, morphological characteristics, and the fungi role. There is also limited teaching material, and the lack of media, tools, and materials in the laboratory is incomplete (Lubis et al., 2017). The lack of teaching material applied in the learning process will induce the student learning outcomes to be less than the maximum.

In the learning process, teaching material is necessary. According to Ruwiyatun (2020), teaching material is one of the most essential components aside

from students and teachers in the learning process. Teaching material can be in the form of printed or non-printed.

The learning process by applying teaching material will give knowledge that establishes through student learning outcomes, and learning outcomes hold a crucial part of the learning process. Teachers will get information about student development in reaching learning goals through learning activities by evaluating the learning outcomes (Khairani & Safitri, 2017).

Innovation in using of various teaching materials is very essential to add insight to students. The habit of using various teaching materials will make it easier to develop the expected quality. It is time for every educator to make teaching material (book) for students. The teachers can create a product, namely teaching material. It will make it easier for students to learn and understand the material that will affect the improvement of their learning

outcomes. The efforts to create an effective, efficient, and attractive learning process require learning resources that can be used and utilized to support higher-quality learning (Nuryasana & Desiningrum, 2020).

Teaching material is one of the components of learning that determine the success of learning process. Therefore, the teaching material should be arranged appropriately. The teaching material is unique, which means the teaching material can only be applied to certain audiences in a certain learning process. It is also specific, which means the content of the teaching material is designed in such a way only to reach certain goals from certain audiences. The teaching systematic is also set to the characteristics of the subject and the characteristics of the students who use it (Magdalena, *et al.*, 2020).

It defines that the teaching material must be arranged and designed with instructional rules because it will be applied to assist and support the learning process. The teaching material on the curriculum content is written in the form of subjects or fields of study with topics/subtopics and details. Therefore, according to the criteria for assessing teaching material in the form of a textbook, there are at least three main components; such as content, appearance, and linguistics component (BSNP, 2014).

In line with the development of teaching material, 21st-century learning requires three skills; life and career skills, technology and media information skills, and learning and innovation skills (Wijaya *et al.*, 2016). These skills train students to have thinking and learning skills, being able to compete in the global era, including asserting the mastery of science, technology, and English. The purpose is to build a fully modern and characterized society in keeping with globalization. It can manifest through education, one of which is the importance of the learning component, namely teaching material that needs development.

Based on the analysis of teaching material used in high schools in Indonesia, it is noticed that generally the content of teaching material is oriented to the formal learning material. The learning process still focused on memorizing, so the students did not understand what they learned (Jufri, 2013). The students have less scientific literacy and pay less attention to the environment and society. It makes students never be triggered to think as their knowledge and experience constructing process to find out concepts and meanings and their relationship to the environment, technology, and society.

The STSE (Science, Technology, Society, Environment) approach attempts to provide comprehension of the environment's role in science, technology, and society, including the role of technology

in its adaptation to science, its benefits to society, and its impact on the environment. Therefore, STSE applied in the learning process makes students can apply their knowledge to improve the quality of human life without endangering the environment (Calado, *et al.*, 2015). STSE can also practice students' scientific literacy skills.

Scientific literacy is necessary for every individual in making decisions. It is because scientific literacy can solve daily life problems in personal or social and produce a beneficial scientific product (Lederman, *et al.*, 2013). Rahayu (2014) description of scientific literacy is intended for everyone, not only those who choose a career in science or specialist in the field of science.

Scientific literacy is an individual scientific knowledge and the use of knowledge to identify questions, acquire new knowledge, explain scientific phenomena, and draw evidence based on conclusions about science-related issues (OECD, 2019). The categories of scientific literacy to analyze teaching material are: (1) The Knowledge of science; (2) The Investigative nature of science; (3) Science as a way of thinking; (4) Interaction of science, technology, and society.

(1) The knowledge of science builds the higher-order thinking skill of students to use the concept of science and technology in solving daily issues and making wise decisions in daily life, and also to analyze the relationship between science, technology, society, and the environment. (2) The investigative nature of science builds the attitude to engage in science or technology by using methods and processes of science such as observation or making charts. (3) Science as a way of thinking creates society to recognize the strengths and limitations of science and technology to advance human welfare. (4) Interaction of science, technology, and society builds the interdisciplinary to consider the aspect of political, economic, moral, and ethical science and technology related to personal issues and global.

According to the earlier research conducted by Susanti *et al.*, (2018) showed that the teaching material based on science, technology, environment, society and scientific literacy (STESL) improved students scientific literacy skill on the bacteria material and had a very good response from students. Ilmi *et al.*, (2017) suggests that biology teachers should strain to set up students' literacy skill because they hold a huge impact on how students study ecology. Another research conducted by Millah *et al.*, (2012) showed that the textbook based on STSE on biotechnology material was developed compatibly to be applied in high school.

The integration between STSE and scientific literacy make students who only know, recognize, and apply

facts/formula to solve problems at first, become accustomed to higher-order thinking skills to solve the problem (Zoller, 2013). Students can use science and technology to solve problems and make responsible decisions in daily life. Besides, they will recognize the strengths and limitations of science and technology to advance human welfare; and consider aspects of science and technology related to personal issues and global.

To face current global development, STSE affects the relationship between students and the real world. It will also trigger students to be more active, creative, and think critically to provide solutions to the problem around them. Students learn to understand a topic deep than those who study using the conventional method. It can also hold more value for facing the globalization era by applying international language in the class discussion. It will become one of the great opportunities for the Indonesian Nation to socialize with the worldwide community (Santoso, 2014). Nevertheless, not every local student is prepared to learn biology delivered in English, so it is required to develop bilingual teaching material by merging two languages, English and Indonesian language on it.

According to the description above, the research aimed to develop a biology teaching material based on STSE (science, technology, society environment) on fungi material to practice scientific literacy for senior high school grade 10th that is stated to be valid.

METHODS

The procedure of the research refers to the Model of Fenrich Instructional Development Cycle conceives some phases such as analysis, planning, design, development, and implementation. (1) analysis contained the curriculum analysis and student analysis; (2) planning is the phase to arrange the content of teaching material by carrying out the lesson plans and literature; (3) design is the phase to complete the whole book design. Draft 1 was evaluated and revised by the supervisor to get draft 2; (4) development is to evaluate draft 2 and produce draft 3. Draft 3 was validated by the validator to get draft 4, and (5) implementation is the trial for limited science students in grade 10th. Every cycle must be evaluated and revised (Fenrich, 2005). The developed product is bilingual teaching material based on STSE (science, technology, society, environment) on fungi material to practice scientific literacy for senior high school grade 10th. This research was conducted in March-May 2022. The phase of development was completed in Biology Department FMIPA UNESA and SMA Khadijah Surabaya.

The data was assessed and validated by a biology educational expert, a fungi material expert, and a biology

teacher of SMA Khadijah Surabaya. The instrument for determining the validity of teaching materials is the sheet of validation instrument based on content, appearance, linguistic, STSE, and scientific literacy components. The validation results were obtained based on the modified Likert scale calculation according to Hadi (1991) with a scale of 1 to 4, then analyzed quantitatively descriptive by using the following equation:

$$\text{Validity score (\%)} = \frac{\sum \text{Obtained Score}}{\sum \text{Maximum Score}} \times 100\%$$

The obtained mark is interpreted based on the eligibility criteria for teaching material. Teaching material is declared eligible if they reach a score of 70% (Riduwan, 2015).

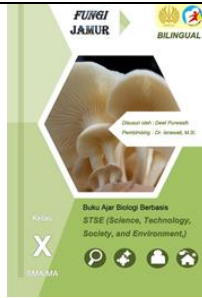
RESULT AND DISCUSSION

The result of this development research will produce the bilingual teaching material based on STSE (science, technology, society, environment) on fungi material for senior high school grade 10th students. This teaching material has Indonesian and English languages on it. The STSE component in this teaching material can practice scientific literacy for students. This development research aimed to produce valid teaching material.

This developed teaching material has components consisting of the cover, the beginning, the content, and the closing. (1) The cover contained a front cover, a spine book, and a back cover. (2) The beginning contained the table of contents, book's characteristics, basic competency, and concept map. (3) The content section contained special features based on STSE and scientific literacy that are up-to-date and representative. The content is written bilingual, using Indonesian and English to make it easier to understand. The specific features in this teaching material are the *lab activity* feature, *STSE Zone* feature, *fungi fact* feature, and *review* feature. (4) The closing section contained summary, assessment, glossary, and index. The components in the developed media can be seen in (Table 1).

Tabel 1. Components in bilingual teaching material based on STSE (Science, Technology, Society, Environment)

No.	Components	Description
A. The Cover		
1.	A Front Cover	The front cover was designed using representative images so that students can

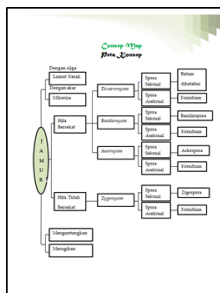


prepare to focus on the topic of fungi.

technology, environment, and society. The activities will train scientific literacy for students.

B. The Beginning

1. Concept Map



The concept map provides an overview of fungi to facilitate the flow of thought in learning.

2. Book's Characteristic



It shows the components and advantages of teaching material to the reader.

C. The Content

1. Lab Activity



This feature provides student activities related to fungi. The activities train scientific literacy for students.

2. STSE Zone



This feature provides articles about certain natural phenomena and contained questions. The phenomena are related to fungi and science,

3. Fungi Fact



This feature contains information and fun facts about fungi.

4. Review



This feature is at the end of each chapter. It contains questions that must be answered by students to obtain enrichment.

C. The Closing

1. Summary



This feature contains a summary of the learning subject to recall students what has been studied.

2. Assessment



It is used to collect data on student learning outcomes.

The teaching material validation was needed to assign the eligibility of the teaching material before being applied in the learning activity of biology class. This assessment instrument of validation was developed based on the eligibility standard of teaching material for SMA/MA by the National Education Standards Corporation (BSNP) 2014. The eligibility of teaching material in the form of textbook can be noticed by three main components; content, appearance, and linguistic component (BSNP, 2014). Because the teaching material

was developed based on STSE (science, technology, society, environment), hence it needs to add the validity of science, technology, society, environment, and scientific literacy components.

The assessment validation of the teaching material was completed into the validation process by a biology education expert, a fungi expert, and a biology teacher. The results of validation showed that the developed teaching material had the validity of content, appearance, and linguistics with a very valid category (Table 2).

Tabel 2. Recapitulation of validation result of bilingual teaching material based on STSE

No.	Aspect	Validator			Average	Description
		V1	V2	V3		
1.	Eligibility of Content					
	Conformity of Material/Content in KI & KD	4	4	4	4	Very Valid
	Sophisticated Content	2	4	4	3.33	Valid
	Material Coverage & Accuracy	4	4	4	4	Very Valid
	Providing a Real Sample in Daily Life	4	4	4	4	Very Valid
	Components Organized Systematically	4	4	4	4	Very Valid
	Category				3.87	Very Valid
2.	Eligibility of Appearance					
	Material Appearance Technique	4	4	4	4	Very Valid
	Material Appearance Proponent	4	4	4	4	Very Valid
	Selected Font Type and Size	4	4	4	4	Very Valid
	Selected Design	4	4	4	4	Very Valid
	Physical Form of the Teaching Material	4	4	4	4	Very Valid
	Category				4	Very Valid
3.	Eligibility of Linguistic					
	Structure of Language	4	4	4	4	Very Valid
	Compatibility to Indonesian Language rules	4	4	4	4	Very Valid
	Compatibility to English Language rules	4	4	4	4	Very Valid
	Symbols and Terms Applied Appropriately	4	3	4	3.67	Very Valid
	Compatibility of Bilingual Components	4	4	4	4	Very Valid
	Category				3.93	Very Valid
4.	Eligibility of STSE					
	STSE Components	4	4	4	4	Very Valid
	Scientific Literacy Components	4	4	4	4	Very Valid
	Relevance STSE with Fungi Material	4	4	4	4	Very Valid
	Compatibility of STSE training Scientific Literacy Skill	4	4	4	4	Very Valid
	Compatibility of Material with Science on STSE	4	4	4	4	Very Valid
	Compatibility of Material with Technology on STSE	4	4	4	4	Very Valid
	Compatibility of Material with Society on STSE	4	4	4	4	Very Valid
	Compatibility of Material with Environment on STSE	4	4	4	4	Very Valid
	Category				4	Very Valid

Note:

Validator 1 (V1): Educational Biology Expert

Validator 2 (V2): Fungi Material Expert

Validator 3 (V3): Biology Teacher of SMA Khadijah Surabaya

Based on the recapitulation in Table 2, three components of content, appearance, and linguistics are 3.87; 4; and 3.93. Based on the three theoretical eligibility criteria above, an overall average score of 3.93 with a percentage of 98% indicates that the teaching material is very valid. Teaching material is declared eligible if they reach a score of 70% (Riduwan, 2015).

Eligibility of Content is stated to be very decent criteria with an overall average of 3.87. However, in the aspect of sophisticated content or content updates, the 1st validator gave a score of 2 because some pictures in the teaching material were taken from out-of-date sources (more than the last five years). Content updates must be taken from the source of the last five years to compile teaching material but some pictures only exist in the primary books/articles that are adapted based on Campbell, *et al* (2016) and Lockwood (2001). In line with the content updates, the content eligibility must contain deep knowledge, up-to-date, and giving curiosity for students (BSNP, 2014). In addition to the content updates, in this teaching material has a *fungi fact* feature which contained up-to-date information and fun facts about fungi. This feature provides to add insight to students regarding the learning material.

Eligibility of Appearance has very decent criteria with a value of 4. According to the National Education Standards Corporation or BSNP (2014), good teaching material must have a coherent concept, simple and concise discussions, and student-centered learning presentations. This teaching material based on STSE provides various learning experiences for students. In line with Huang *et al* (2020) stated that a good design and an attractive media could increase students' learning motivation and ability to solve problems in life.

Eligibility of Linguistic is stated to be very good with an overall average of 3.93. The linguistic eligibility contained aspects of conformity with the rules of the Indonesian and English language in the form of using standard language; use of terms/symbols/icons; communicative in the form of easy-to-understand sentences; dialogic and interactive aspects. However, in the aspect of symbols and terms, the 2nd validator gave a score of 3. It is because the researcher used symbols and terms that were not fixed yet. It was suggested that symbols and terms must be consistent for the reader to understand easily, hence revision was made to improve the teaching material. According to Santoso (2014) stated that each language has its uniqueness and originality so not all terms can have equivalent words according to the intended meaning, therefore it is necessary to choose the right word to match what is intended in the sentence.

Eligibility of STSE has very decent criteria. It has score of 4 for each aspect. The STSE feature facilitates students to be close to real life and expected to develop knowledge related to science, technology, society, and the environment. Regarding the literacy of students, the knowledge they build from concepts based on science, technology, environment, and society will be applied by students in everyday life by solving the problem related to natural phenomena in the surrounding environment (Khasanah, 2015). The developed teaching material provided articles related to certain natural phenomena and current problems that happen in the surrounding environment.

Akcaý and Akcaý (2015) stated that in addition to understanding the basic concept of science, STSE can also improve science process skills, science application, creativity, and improve better behavior. It shows that students have higher scientific literacy than students who are taught through conventional methods only from books.

In addition to the STSE feature, there is the *Review* feature which encourages the curiosity of students by providing exercise questions that can be answered by students to obtain enrichment. Another feature is a *Lab Activity* feature. This feature provides students with activities to analyze information, solve problem, identify information, and apply experience to a new situation. These activities train scientific literacy. The literacy indicators were adapted from three scientific literacy competencies according to the OECD (2016) which used scientific knowledge and attitude to identify scientific issues, explain phenomena, and draw a conclusion based on facts so that they can understand and make decisions scientifically.

STSE can evolve individuals who scientifically educated and understand how science, technology, and society influence each other to solve the problem in daily life. The ones who know, are known as literate human beings. They use knowledge from facts, concepts, and scientific processes to learn to think logically (Autieri, et al., 2016).

This teaching material is declared eligible if it reaches a score of 70% (Riduwan, 2015). Based on the description and the data of the three theoretical eligibility criteria above, the bilingual teaching material based on STSE (science, technology, society environment) on fungi material to practice scientific literacy for senior high school grade 10th is declared eligible with an overall average of score of 3.93 with the percentage of 98%. It indicates that the teaching material is very valid.

ACKNOWLEDGEMENT

This research could not be appropriately manifested without the help of various parties. Therefore, the researcher would like to thank Nur Qomariyah, S.Pd., M.Sc. and Dr. Mahanani Tri Asri, M.Si., as validators on this bilingual teaching material based on STSE (science, technology, environment, society) for senior high school grade 10th. Thanks also to Khusrotul Lailiyah, S.Pd. as biology teacher of SMA Khadijah Surabaya who also reviewed this product.

CONCLUSION

The results of the research show that the development of bilingual teaching material based on STSE (science, technology, society, environment) on fungi material to practice scientific literacy for senior high school grade 10th had been well-developed. The eligibility test results of content, appearance, and linguistic component were stated very valid with a percentage of 98%.

SUGGESTION

Suggestions that can be given based on the research that has been conducted are as follows.

1. Further research must determine the effect of teaching material on students.
2. It is necessary to develop a similar teaching material based on STSE for the other biological materials.

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