UNIVERSITAS SEBELAS MARET
BIOEDUKASI: JURNAL PENDIDIKAN BIOLOGI
https://jurnal.uns.ac.id/bioedukasi
1693-265X (Print) | 2549-0605 (Online)

The Development of Teaching Material of In Vitro Plant Breeding Based on Scientific Literacy

Fauziyah Harahap [1, *], Az-Zahra Shakila Salsabila [2]

Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Medan, Medan-Indonesia.
[1] fauziyahharahap@unimed.ac.id *; [2] zahrashakila2000@gmail.com
* Corresponding author: fauziyahharahap@unimed.ac.id

Submission : 29/10/2021
Revision : 03/01/2022
Accepted : 28/02/2022

ABSTRACT

This development research was carried out based on the observations of lecturers and students Department of Biology at Universitas Negeri Medan who stated that the tissue culture course was still quite difficult to learn, and the level of scientific literacy in Indonesia according to PISA was still relatively low. So, the purpose of this development research in general is to improve student scientific literacy, one of which is by developing tissue culture teaching materials. The research method for developing tissue culture teaching materials refers to the Dick & Carey model. However, this research has only reached the stage of designing and conducting formative evaluation. Analysis of the data used in this development research using quantitative descriptive data analysis. The result showed that the development of teaching material of in vitro plant breeding based on scientific literacy with a feasibility level based on material expert validation obtained a percentage of 91% in the very worthy category, learning design expert validation obtained a percentage of 95% in the very worthy category, layout design expert validation obtained a percentage of 99,2% in the very worthy category, response from lecturer of tissue culture course obtained a percentage of 95% in the very worthy category, and student responses obtained a percentage of 87% in the worthy category.

Keywords: Development, Teaching Material, Tissue Culture, In Vitro, Scientific Literacy

Introduction

Teaching materials are all forms of material used to assist instructors in carrying out teaching and learning activities in class. The material in question can be in the form of written or unwritten material. According to Sanjaya (2016), teaching materials are a form of learning resources that can be in the form of textbooks, modules, video programs, films, slide programs and so on which are used to store learning messages. One of the teaching materials that is often used is the textbook. Textbooks are one book that is a reference for students' learning activities (Suwarni, 2015). Textbooks are also used as a useful reference for all people because the material in textbooks is the realization of the material listed in the curriculum.

Textbooks have an important role in learning. Textbooks are an embodiment of the curriculum and competencies that students want to achieve. In addition, textbooks contribute to the development of students' competencies in applying their scientific knowledge. Therefore, textbooks containing aspects of scientific literacy will affect the development of competence and increase students' scientific literacy (Riadiyani, 2009). According to Amalia (2009), textbooks are a tool to improve scientific literacy. The scientific literacy ability of Indonesian students from the results of the 2012 PISA international study when compared to the results of the 2003, 2006 and 2009 PISA studies, the scientific literacy ability of Indonesian students in 2012 relatively did not increase. The average scientific literacy score of Indonesian students in 2003 was 395, in 2006 was 393 and in 2009 was 383. The results of the 2012 PISA study show that the level of scientific literacy of Indonesian students has an average score that is not much different from the results of the study in previous years. previously and this score is below the standard average of PISA (OECD, 2013).

As stated by PISA that the literacy level of Indonesian students is very low, it can be considered a serious problem and needs special attention. The low scientific literacy of Indonesian students is caused by learning that has so far been irrelevant in the view of students. With the pattern of science teaching that has been used in schools, students have come to think that science is a separate lesson from the world they are in. The learning and assessment applied still focuses on the content dimension and forgets the process and context dimensions of science. Based on this, learning in schools should be more directed at content that connects the context of science as a means with the aim of increasing students' scientific literacy.

According to Kurniawati & Rahayu (2014), in studying plant tissue structure material. Especially in tissue culture, students often have difficulty. This difficulty can be caused by the absence of other learning media besides textbooks which are used as the only learning media and no other supporting media used in learning other than textbooks on plant tissue structure material. In addition, the availability of microscopes is also limited so that at the time of learning, not all can observe various kinds of plant tissues. The tissue culture course is still included in the scope of the discussion of biotechnology studies. In this course, the material presented is quite diverse where the core of the discussion focuses on methods to isolate parts of plants such as protoplasm, cells, tissues and organs, and grow them in aseptic conditions, so that the plant parts can multiply and regenerate into complete plant. Through this course, students get the opportunity to develop competencies within themselves, especially in the ability to become biology teachers, biologists, researchers,

entrepreneurs, who must be master in course material, especially tissue culture, and their competencies can be developed for other opportunities (Harahap, 2008).

The aim of plant tissue culture as one of science course is to enable students to apply scientific process skills in learning process (Harahap, et al. 2019). Good quality tissue culture learning materials with adequate standards will be able to help students in learning, so that competency can be achieved (Khabib, et al. 2021). Tissue culture learning material includes components of tissue culture material in accordance with the subject required in the national curriculum, and contains enrichment material so that students' knowledge of tissue culture subject matter increases. Tissue culture material in tissue culture learning materials must be complete, systematic, easy to understand, interesting, innovative, motivate independent learning, align with the curriculum, and have additional material as enrichment in accordance with the characteristics of the learner.

Based on the analysis of reference books that is kultur jaringan tanaman by Fauziyah Harahap, there are 10 chapters with introductory topics on tissue culture, that are: tissue culture laboratories, tissue culture media, hormone concepts, in vitro plant breeding, somaclonal diversity, production of secondary metabolites, preservation of germplasm of in vitro culture, plant acclimatization, in vitro culture, and mango plant tissue culture. In vitro plant breeding has indeed been discussed in this book, but not based on scientific literacy. So, in this development teaching materials the topic of in vitro plant breeding developed based on scientific literacy components. Some of biology students have difficulty finding supporting books in learning plant tissue culture because of the limited books available in the library. This causes constraints on learning resources in the form of learning support books (Suprapto, et al. 2021). So, that it makes difficult for students to understand and apply tissue culture learning in a study.

The development of innovative tissue culture learning materials for teaching tissue culture needs to be done to meet good quality teaching materials that can improve Indonesia's human resources in facing global competition. One effort to improve the quality of education is through the provision of quality subject matter, and can be started from the provision of learning materials (Sudiyono, et al. 2020). The good materials must be able to present teaching materials in accordance with the demands of the curriculum, follow the development of science and technology (IPTEK), and can bridge the learning so that the competencies that have been set can be achieved. Teaching material in a tertiary institution is a part that must be prepared by lecturers in the tertiary institution because every tertiary institution has the autonomy of higher education standards that is determined, compiled, and developed by the tertiary institution. This is contained in Ministry of Education and Culture Regulation No. 50 of 2014 concerning the system of quality assurance of higher education, so that each university must prepare teaching materials that are in accordance with the conditions of students at the tertiary institution (Nurhamid, et al. 2021).

From the results of the analysis of the tissue culture book used by students department of biology Universitas Negeri Medan, it was found that the existing tissue culture textbook emphasized the content dimension rather than the process dimension. The teaching material that the researchers choose was about tissue culture

in plants, because based on the results of interviews with lecturers and students of biology education Universitas Negeri Medan, it was suggested that tissue culture was a subject that was considered difficult for students. The lack of information and references to this textbook is the reason for the preparation of tissue culture textbook based on scientific literacy. This tissue culture textbook based on scientific literacy is expected to help students in tissue culture courses. Selection of appropriate textbooks is expected to increase understanding of science which in turn can improve students' scientific literacy. To be able to choose a good textbook, we need a way of developing books that involves aspects that contain scientific literacy, namely content, process, and context (Trisnayanti, et al. 2021).

According to Harahap (2010) that in practice many of the materials in this course are relatively new for students, seem difficult, monotonous, and abstract for students. This is evident from the results of student examinations for the topic "tissue culture media, several media compositions, organ culture (roots, meristems, shoots), haploid plant production (anther culture, pollen, ovules)" only getting an average score of 6,4 (from a score range of 1-10). As revealed by researches Zulpadly, et al. (2016) where, in his research, there were many students who did not complete each indicator of the biotechnology material being taught. The material that has high difficulty is to explain the tissue culture process with a percentage of 63,44% with indicators to sequence the steps in tissue culture and identify the process and advantages of doing tissue culture. In this material, it is known that many students do not understand the process and steps in conducting tissue culture, students also do not understand the advantages and disadvantages of tissue culture.

Based on the results of the student needs analysis that has been carried out through distributing questionnaires to students department of biology Universitas Negeri Medan, it was found that 89% of students stated that they really need textbook based on scientific literacy in tissue culture courses. As many as 71% of students have difficulty learning the material of in vitro plant breeding. The difficulties experienced by students are in understanding the material, there are words that have just been learned, and understanding figures and analyzing data. Based on the results of the student needs analysis above, the tissue culture textbook based on scientific literacy was developed. Understanding these fundamental aspects of scientific literacy will help a student to comprehend thoroughly the universe of science. In other words, students' scientific literacy skills can be improved, one way is by developing textbooks based on scientific literacy (Abdurrahman, et al. 2020).

The existing textbooks emphasize the content dimension rather than the process and context dimensions as demanded by PISA, which is the main factor that should be suspected of causing the low literacy level of Indonesian children in PISA (Firman, 2007). According to the Organization for Economic Cooperation and Development (OECD, 2003) scientific literacy is defined as the capacity to use scientific knowledge, identify questions and draw fact-based conclusions to understand the universe and make decisions from changes that occur due to human activities. Science literacy is important for students to be mastered in relation to how students can understand the environment, health, economy and other problems faced by modern societies that depend heavily on technology and the progress and development of science (Yusuf, 2003).

Based on the 2006 PISA, the average value of the science literacy component of Indonesian children is below the ability scale which places Indonesia in 50th place out of 57 countries under Thailand, which has an average score of 421 in the 46th position. At this level of ability students are generally only able to remember facts, terminology and laws of science and use general science knowledge in drawing and evaluating conclusions (Hayat, 2003). The weakness of science learning in Indonesia mainly lies in the knowledge of how process skills are implemented and the orientation of science learning (Darliana, 2011).

Based on this, a research entitled "The Development of Teaching Material of In Vitro Plant Breeding Based on Scientific Literacy". This tissue culture textbook contains learning materials that pay attention to the needs and abilities of students in the implementation of learning. With this textbook, it can provide references and add insight for students in growing scientific attitudes so that learning outcomes are better. In addition, this textbook can provide an evolution of the student paradigm that tissue culture is monotonous to be more interesting.

Methods

This research was conducted in Department of Biology, FMIPA, Universitas Negeri Medan, from May until September 2021. This type of research is Research and Development (R&D) research. The research design of R & D is a science and technology activity that aims to utilize proven scientific principles and theories to improve the functions, benefits and applications of existing science and technology or produce new technologies (Hanafi, 2017). The product that will be developed and tested for effectiveness is the tissue culture textbook based on scientific literacy. In this study, the Dick & Carey development model was modified until the eighth step, namely formative evaluation, where the design, process, or program is considered complete. The subjects in this study were expert validators (material experts, learning design experts, layout design experts), lecturers in tissue culture courses at Universitas Negeri Medan, and students Department of Biology Universitas Negeri Medan. The objects used in this research is the developed tissue culture textbook based on scientific literacy. In conducting this research the techniques used for collecting data is an observation, questionnaire, and documentation. Analysis of the data used in this research using quantitative descriptive data analysis.

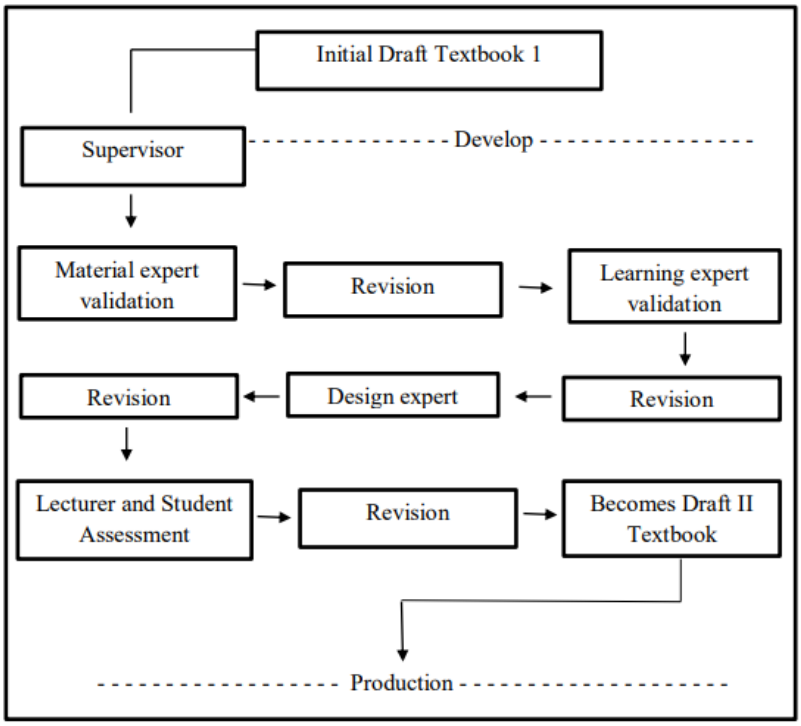

Figure 1. Research Design of R&D

The instrument used in the validation of this book is a questionnaire in the form of a rating scale that has weights with several indicators. The instruments that have been filled in by experts, lecturers, and students will then be analyzed using a Likert scale. Products that have been made are then assessed by experts with a non-test questionnaire, namely with alternative answers including: very worthy (4), worthy (3), less worthy (2), and not worthy (1). Product validation analysis is carried out by converting quantitative data on the Rating Scale into qualitative data, namely adding up the scores of each statement item from each aspect of the assessment, calculating the average total score of each aspect, converting the average score into a percentage, and converting it into a feasibility category based on 4 scale conversion guidelines. Aspects and indicators to be assessed by experts, lectures, and students can be seen in the table below. Then conclude the results from all the tables that the tissue culture textbooks based on scientific literacy are said to be suitable for use if they are in the range of "Worthy" and "Very Worthy" criteria from the results of calculations using the formula and the number in the form of a percentage (%).

There are two aspects of assessment developed, that are the suitability of material with basic competencies and components of scientific literacy. These following are the grids of textbook based on scientific literacy product quality validation for material expert.

Table 1. The Questionnaire Grids for Material Expert

Component	Indicator	Item Number
Suitability of material with basic competencies	Completeness of the material	2
	Material breadth	3

Component	Indicator	Item Number
Components of scientific literacy	Science as a body of knowledge	7
	Science as a way of investigating	5
	Science as a way of thinking	7
	Interaction between science, technology and society	2
Total		26

(BSNP, 2008)

There are four aspects of assessment developed, that are material suitability, systematics of material delivery, textbook efficiency, and language. These following are the grids of textbook based on scientific literacy product quality validation for learning design expert.

Table 2. The Questionnaire Grids for Learning Design Expert

Component	Indicator	Item Number
Material suitability	Completeness of the material	2
	Material breadth	2
	Depth of material	4
Systematics of material delivery	Systematic delivery of material	4
Textbook efficiency	Centering students in learning	4
Language	Straightforward	4
	Narrative and concise	3
Total		23

(BSNP, 2008)

There are two aspects of assessment developed, that are cover design and design of textbook content. These following are the grids of textbook based on scientific literacy product quality validation for layout design expert.

Table 3. The Questionnaire Grids for Layout Design Expert

Component	Indicator	Item Number
Cover design	Consistent pattern	1
	Good center of view	1
	Good color contrast	1
	Easy to read font size and type	1
	Writing layout	1
	The image has a proportional shape	1
	Typography	1

Component	Indicator	Item Number
Content textbook design	Illustration / picture content	1
	Textbooks	2
	Layout	3
Total		13

(BSNP, 2008)

There are three aspects of assessment developed, that are textbook display, the feasibility of material presentation, and scientific literacy. These following are the grids of textbook based on scientific literacy product quality validation for lecturer in tissue culture course.

Table 4. The Questionnaire Grids for Tissue Culture Course Lecture

Component	Indicator	Item Number
Textbook display	Picture	1
	Design	2
	Attractiveness	1
	Wrinkling	1
	Clarity of writing	3
	Language	6
The feasibility of material presentation	Quality of material	4
	Motivation	5
	Process in learning activities	6
	Acquisition of new information	7
Scientific literacy	Science as A body of knowledge	7
	Science as a way of investigating	5
	Science as a way of thinking	7
	Interaction between science, technology and society	2
Total		44

(BSNP, 2008)

Questionnaires were made to see student' responses to the products developed, there are two indicators that students will respond to regarding the textbook based on scientific literacy. Below is a grid of questionnaires for student responses to the textbook developed.

Table 5. The Questionnaire Grids for Students Responses

Component	Indicator	Item Number
Textbook display	Picture	1
	Design	2
	Attractiveness	1
	Wrinkling	1
	Clarity of writing	3
	Language	6
The feasibility of material presentation	Quality of material	2
	Motivation	2
	Process in learning activities	4
	Acquisition of new information	1
Total		23

(BSNP, 2008)

Results and Discussion

Based on the results of research conducted at Department of Biology Universitas Negeri Medan, it is known that learning resources are less varied and less interesting, textbooks still focus on the content dimension rather than the process dimension, and there are no adequate alternative learning resources to improve scientific literacy. Students also still have difficulty understanding the material used as a source of independent learning. Learning resources according to Navy (2013) are an important factor in learning management. Therefore, it is hoped that the existence of this tissue culture textbook based on scientific literacy can help students understand the material, especially on the topic of in vitro plant breeding.

The result of the development research conducted in this study was the development of the tissue culture textbook based on scientific literacy on the topic of in vitro plant breeding. In accordance to Ardhana's (2002) statement that development research is conducted to bridge the gap between researchers and educational practice. The tissue culture textbook based on scientific literacy is a reference book that is used as a companion/ additional book in learning tissue culture courses. The tissue culture textbook based on scientific literacy developed is tailored to the needs of learning. The material discussed in this tissue culture textbook is in vitro plant breeding. The material in this tissue culture textbook based on scientific literacy emphasizes four components of scientific literacy, namely science as a body of knowledge, science as a way of investigating, science as a way of thinking, and interaction between science, technology and society. In the research of Harahap et al. (2016) stated that textbooks are information, tools and learning materials that are systematically arranged and used in the learning process.

The initial steps taken in the preparation of tissue culture textbook based on scientific literacy on the topic of in vitro plant breeding include determining ideas, analyzing the materials used, preparing Microsoft Word applications, adapting the materials to scientific literacy. The content of the textbook consists of a front cover, a preface, a table of contents, a list of figures, a list of tables, an introduction, a middle

cover, a concept map and learning outcomes, science as a body of knowledge, science as a way investigating, science as a way of thinking, interaction between science, technology and society, a references, a glossary, an index, and a behind cover.

The procedure for research and development carried out to develop tissue culture textbook based on scientific literacy using the steps from the modified Dick & Carey development model to the eighth step can be seen as follows:

Phase 1: Needs and objectives analysis

Analysis of the needs and objectives of this research and development is to develop a tissue culture textbook based on scientific literacy on the topic of in vitro plant breeding. The results of the needs analysis show that educators have not created effective and creative learning that supports student scientific literacy, therefore researchers are trying to develop a tissue culture textbook based on scientific literacy on the topic of in vitro plant breeding which can improve students' scientific literacy skills.

Phase 2: Learning analysis

From the analysis of needs and objectives, then an analysis of learning is carried out to determine the skills that must be mastered by students. The skills in question are Learning Outcomes to be developed namely students are expected to be overall able to explain and describe the differences in various tissue culture techniques such as organ culture, cell culture and callus culture, and be able to design experiments for making callus cultures.

Phase 3: Student and context analysis

From the identification results, it was found that the scientific literacy of students was still relatively low. This can be seen from the results of the 2012 PISA study showing that the level of scientific literacy of Indonesian students has an average score that is not much different from the results of studies in previous years and this score is below the average standard of PISA. Currently, students also often experience difficulties in studying tissue culture material, especially on the topic of in vitro plant breeding. This can be seen from the distribution of questionnaires to students department of biology at the Universitas Negeri Medan, it was found that 89% of students experienced difficulties in studying tissue culture material, especially on the topic of in vitro plant breeding. Therefore, the characteristics of students that are expected in the development of this textbook are to increase reading and literacy science students' interest, increase students' thinking power and curiosity, and pay attention to the needs and abilities of students in the implementation of learning. With this textbook, it is hoped that it can provide references and add insight for students in growing scientific attitudes so that learning outcomes are better. Meanwhile, the analysis of the

learning context includes the attitude of students' interest in learning tissue culture courses and increasing students' scientific literacy.

Phase 4: Formulating performance goals.7

The objectives in learning tissue culture on the topic of in vitro breeding are as follows:

1. Students can describe various tissue culture techniques such as Organ Culture, Cell Culture, Callus Culture.
2. Students can explain the differences in the techniques of Organ Culture, Cell Culture, Callus Culture.
3. Students can design experiments for the manufacture of callus cultures.

Phase 5: Developing the instrument

In the development stage of this research instrument, the researchers developed aspects and indicators in the validation and response questionnaires that were used to determine the assessment of the textbooks that had been developed. In order for this instrument to be used as an assessment, it is necessary to validate the instrument that has been developed. After the instrument has been validated by the validator, the instrument is feasible to use to get textbook assessments from material experts, learning design experts, layout design experts, responses from lecturer of tissue culture courses, and student responses.

Phase 6: Develop learning strategies

The steps for developing learning strategies are set out in the following table:

Table 6. Development of Learning Strategy

Meeting	Sub-Learning Outcomes-Courses	Indicator	Learning Method (Time Estimation)	Learning Material
1	Student: 1. To know several types of tissue culture techniques such as Organ Culture, Cell Culture, Callus Culture. 2. To know the differences in the techniques of Organ Culture, Cell Culture, Callus Culture. 3. To know how to make callus cultures.	Student: 1. To describe various tissue culture techniques such as Organ Culture, Cell Culture, Callus Culture. 2. To explain the differences in the techniques of Organ Culture, Cell Culture, Callus Culture. 3. To design experiments for the manufacture of callus cultures.	Read teaching materials; experiment; critical analysis (100 minutes)	In Vitro Plant Breeding

Phase 7: Developing and selecting learning materials

After the development of learning strategies is completed, the next step is to plan the development of teaching materials. The product to be developed is a tissue culture textbook based on scientific literacy. At this stage, the development, compilation, and manufacture of tissue culture textbook based on scientific literacy are carried out on the topic of in vitro plant breeding. At the initial development stage of the tissue culture textbook based on scientific literacy using the Microsoft Word application. This application serves to help design textbooks before they are printed. The next step is to select the book format. The paper size used in making this tissue culture textbook based on scientific literacy is A4 paper (21 × 29,7) cm and the font type used is Times New Roman with a size of 12 pt. Then the next step is to design a draft book that begins with determining the chapter to be written. The chapters are: In Vitro Plant Breeding.

The results of the design format for tissue culture textbook based on scientific literacy can be seen in the table below:

Table 7. Design of a Tissue Culture Textbook Based on Scientific Literacy

Title of Book: Buku Ajar Kultur Jaringan Berbasis Literasi Sains
Preface
Table of Content
List of Figures
List of Tables
Introduction
Chapter: In Vitro Plant Breeding
References
Glossary
Index

Phase 8: Designing and conducting formative evaluation

a. Material Expert Validation

Material validation has assessment indicators including material completeness, material breadth, science as a body of knowledge, science as a way of investigating, science as a way of thinking, and interaction between science, technology and society. Material expert validators who have assessed tissue culture textbook based on scientific literacy on the topic of in vitro plant breeding according to the textbook assessment sheet by material experts.

Table 8. Assessment Results and Eligibility Percentage of Material Expert

Num	Aspect	Indicator	Percentage (%)	Criteria
1	Suitability of material with basic competencies	Completeness of the material	100	Very Worthy
		Material breadth	92	Very Worthy
2	Components of scientific literacy	Science as a body of knowledge	89	Very Worthy
		Science as a way of investigating	90	Very Worthy
		Science as a way of thinking	93	Very Worthy
		Interaction between science, technology and society	87,5	Very Worthy
Average Score			91	Very Worthy

From the two aspects that have been assessed by the material, the average assessment of the material expert validator at the stage after the revision is with a feasibility percentage of 91%. Based on the results of the material expert's assessment, it is known that the feasibility percentage score is in the very worthy category. Thus, the results of the material expert validation show that the tissue culture textbook based on scientific literacy on the topic of in vitro plant breeding are suitable for use in learning.

This shows that the tissue culture textbook based on scientific literacy on the topic of in vitro plant breeding has a good qualification value in terms of material. Where material experts assess the suitability of materials with basic competencies and components of scientific literacy. The feasibility level of textbooks assessed by material experts is based on the suitability of the material presented with the core competencies and basic competencies that have been determined in the curriculum. Purnomo & Mulyadi (2006) states that textbooks must meet certain criteria and one of the important criteria that can be used to see the quality of textbooks is their suitability with the curriculum. Naturally, the materials in the textbooks must be in accordance with the curriculum used. If the textbooks used by students are not in accordance with the curriculum, the expected competencies will be difficult to achieve. Tarigan, D. and Tarigan, H. G. (1993) stated that textbooks are closely related to the applicable curriculum. A good textbook must be relevant and support the implementation of the curriculum. The scoring percentage of this textbook obtained a different score on each indicator and item. Thus the contents of the textbook material can be justified scientifically, correctly and in accordance with the learning objectives.

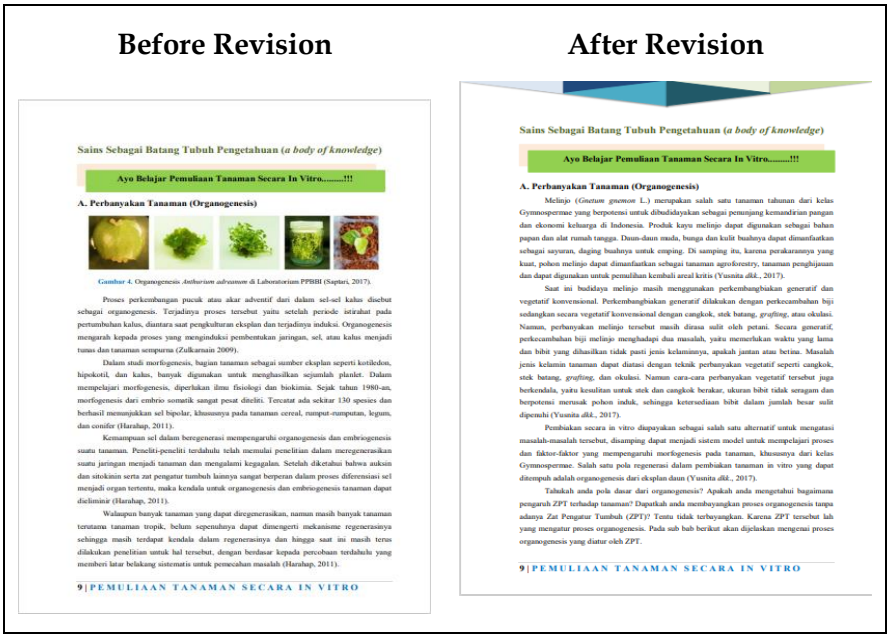

Figure 2. Correction of Adding Material Content with Newest Journal

Improvements made are adding material content to textbooks with the latest journals.

b. Learning Design Expert Validation

Learning design validation has assessment indicators including completeness of the material, material breadth, depth of material, systematic delivery of material, centering students in learning, straightforward, then narrative and concise. The learning design expert validator who has assessed the tissue culture textbook based on scientific literacy on the topic of in vitro plant breeding is in accordance with the textbook evaluation sheet by the learning design expert.

Table 9. Assessment Results and Eligibility Percentage of Learning Design Expert

Num	Aspect	Indicator	Percentage (%)	Criteria
1	Material suitability	Completeness of the material	100	Very Worthy
		Material breadth	87,5	Very Worthy
		Depth of material	100	Very Worthy
2	Systematics of material delivery	Systematic delivery of material	93,75	Very Worthy
3	Textbook efficiency	Centering students in learning	93,75	Very Worthy
4	Language	Straightforward	100	Very Worthy
		Narrative and concise	92	Very Worthy
Average Score			95	Very Worthy

From the four aspects that have been assessed by learning design experts, the average assessment of the learning design expert validators at the post-revision stage

is with a feasibility percentage of 95%. Based on the results of the assessment of the learning design expert, it is known that the feasibility percentage score is in the very worthy category. Thus, the results of the validation of the learning design experts indicate that the tissue culture textbook based on scientific literacy on the topic of in vitro plant breeding are suitable for use in learning.

Riyanto (2013) states, there are at least four conditions that must be met if a teaching material is said to be good. First, the scope of the material or content is in accordance with the curriculum. Second, the presentation of the material meets the learning principles. Third, good language and legibility. Fourth, the format of an interesting book or graphic. Judging from the four requirements that must be possessed by good teaching materials, the textbooks that have been developed have met these four standards so that they can be categorized into very worthy criteria. With these qualifications, it can be said that tissue culture textbook based on scientific literacy on the topic of in vitro plant breeding can be used by students.

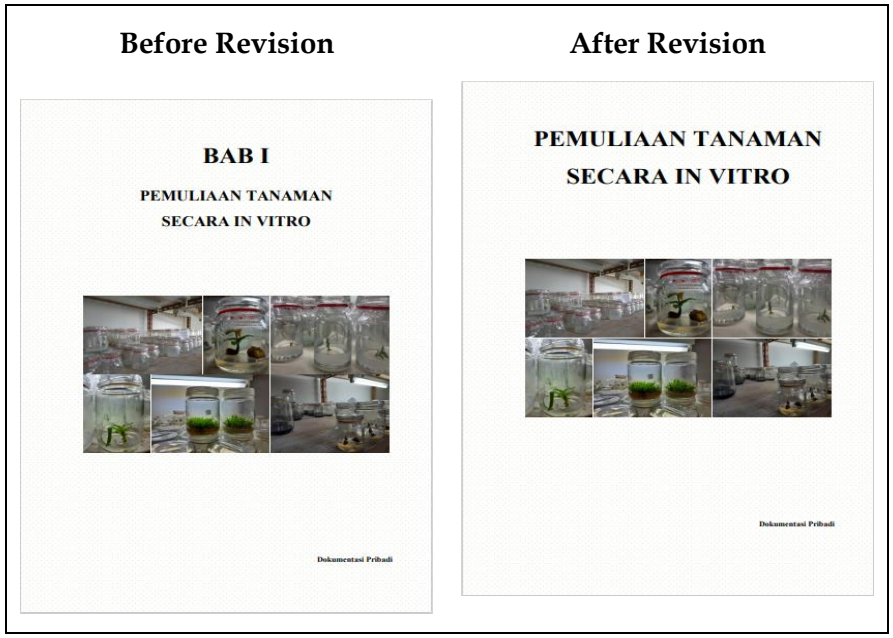

Figure 3. Correction of Chapter System

Improvements made were eliminating the chapter system because there was only one chapter discussed in the textbook, especially in the middle cover of the book.

c. Layout Design Validation

Layout design validation has assessment indicators including completeness of the material, material breadth, depth of material, systematic delivery of material, centering students in learning, straightforward, then narrative and concise. The learning design expert validator who has assessed the tissue culture textbook based on scientific literacy on the topic of in vitro plant breeding is in accordance with the textbook evaluation sheet by the layout design expert.

Table 10. Assessment Results and Eligibility Percentage of Layout Design Expert

Num	Aspect	Indicator	Percentage (%)	Criteria
1	Cover design	Consistent pattern	100	Very Worthy
		Good center of view	100	Very Worthy
		Good color contrast	100	Very Worthy
		Font size and type is easy to read	100	Very Worthy
		Writing layout	100	Very Worthy
		The image has a proportional shape	100	Very Worthy
2	Design of textbook content	Layout	92	Very Worthy
		Typography	100	Very Worthy
		Illustration/ picture content	100	Very Worthy
		Textbooks	100	Very Worthy
Average Score			99,2	Very Worthy

From the two aspects that have been assessed by the layout design expert, the average assessment of the layout design expert validator at the post-revision stage is with a feasibility percentage of 99,2%. Based on the results of the layout design expert's assessment, it is known that the percentage score of the feasibility is in the very worthy category. Thus, the results of the validation of layout design experts indicate that the tissue culture textbooks based on scientific literacy on the topic of in vitro plant breeding are suitable for use in learning.

The developed textbooks produce clear images and writing, printed in color, so that they look attractive. Color is an important component in the presentation of learning resources. The display of colorful and clear images makes students interested and motivated to read further on the material presented (Mardiansyah, 2013, unpublished). The criteria for images used in textbooks are also appropriate, Ayuhanna (2015) states that the selection of images with good brightness levels, not blurry or not broken, and colors that are not flashy and equipped with appropriate image descriptions and has clarity of image sources are criteria for images. the good one. Thus adding color combinations to the design as well as to visualize objects so as to provide a pleasant atmosphere for the reader. In addition, according to Komalasari (2014) an image or photo can provide a real picture that shows the real object, provides a more vivid and precise explanation meaning than words so as to stimulate students' thinking skills. Thus, learning resources will have a positive effect on learning activities, especially in increasing students' learning motivation.

Figure 4. Correction of Front Cover

The improvements made are fixing the front cover by tidying up the writing using center alignment, removing many figure and using one figure, then changing the background and text colors to make them aligned and easy to read.

d. Response from Lecturer of Tissue Culture Course

After validating the textbooks, the research was continued by providing a questionnaire on the responses of the tissue culture course lecturers to the tissue culture textbook based on scientific literacy on the topic of in vitro plant breeding which were distributed. The assessment indicators include picture, design, attractiveness, wrinkling, clarity of writing, language, quality of material, motivation, process in learning activities, acquisition of new information, science as a body of knowledge, science as a way of investigating, science as a way of thinking, and interaction between science, technology and society.

Table 11. Assessment Results and Eligibility Percentage of Response from Lecturer of Tissue Culture Course

Num	Aspect	Indicator	Percentage (%)	Criteria
1	Textbook display	Picture	75	Worthy
		Design	100	Very Worthy
		Attractiveness	100	Very Worthy
		Wrinkling	100	Very Worthy
		Clarity of writing	83	Very Worthy
		Language	100	Very Worthy
2		Quality of material	100	Very Worthy
		Motivation	87,5	Very Worthy

Num	Aspect	Indicator	Percentage (%)	Criteria
	The feasibility of material presentation	Process in learning activities	100	Very Worthy
		Acquisition of new information	100	Very Worthy
3	Scientific literacy	Science as a body of knowledge	96	Very Worthy
		Science as a way of investigating	95	Very Worthy
		Science as a way of thinking	89	Very Worthy
		Interaction between science, technology, and society	100	Very Worthy
	Average Score		95	Very Worthy

From the three aspects that have been assessed by the tissue culture course lecturer, the average assessment of the tissue culture course lecturer at the post-revision stage is with a feasibility percentage of 95%. Based on the results of the assessment by the lecturer of the tissue culture course, it is known that the percentage score of eligibility is in the very worthy category. Thus, the results of the validation of the tissue culture lecturers show that the tissue culture textbooks based on scientific literacy on the topic of in vitro plant breeding are suitable for use in learning. Gagne (1979) states that the best book in the world will not fulfill its function and role if the book is not liked by a teacher or lecturer. A good book must also be interesting, easy to understand and motivate the reader and explicit (Wibowo, 2016).

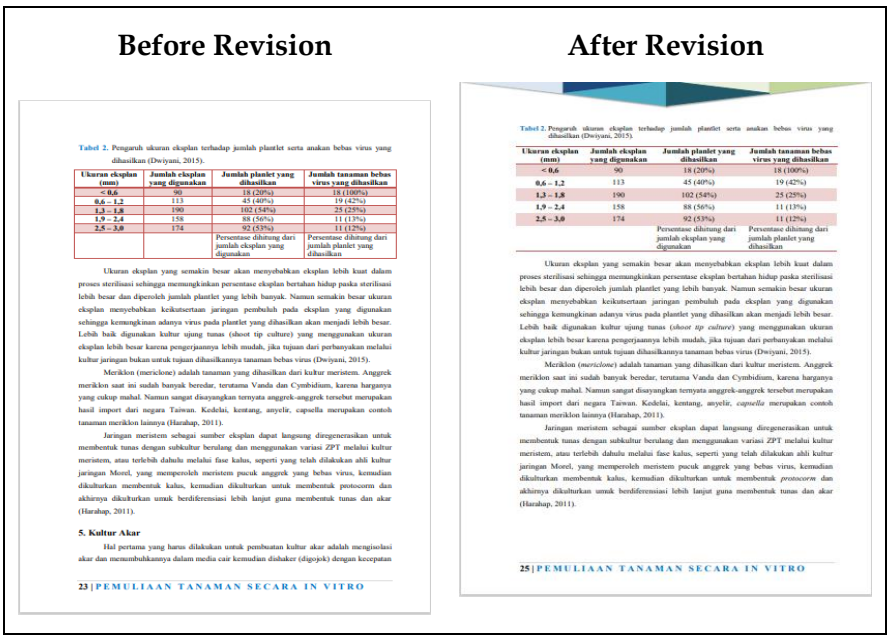

Figure 5. Correction of Tables Format

The improvement made is to change the table that was previously a closed table to an open table.

e. Student Response

The distribution of the questionnaire was carried out to determine student responses to the assessment of tissue culture textbook products based on scientific literacy which was distributed to 5th semester of 30 students from Department of Biology Universitas Negeri Medan who were taking tissue culture courses, there were 23 statements in the student assessment questionnaire of the textbooks. Taking student responses using a student response questionnaire which consists of two aspects, namely the appearance of the textbook and the presentation of the material. This data analysis was conducted to describe student responses to the use of textbooks that have been developed.

Table 12. Recapitulation results of student response

Num	Aspect	Indicator	Percentage (%)	Criteria
1	Textbook display	Picture	91	Very Worthy
		Design	84	Very Worthy
		Attractiveness	84	Very Worthy
		Confusion	87,5	Very Worthy
		Clarity of writing	89	Very Worthy
		Language	85	Very Worthy
2	The feasibility of material presentation	Quality of material	86,5	Very Worthy
		Motivation	85	Very Worthy
		Process in learning activities	88	Very Worthy
Average Score			87	Very Worthy

Table 4.7 is a recapitulation results of student responses to textbook products reaching an average percentage of 87% with very worthy criteria, this means that tissue culture textbook based on scientific literacy developed by researchers have a high feasibility to be used as a tool in tissue culture learning especially on the topic of in vitro plant breeding. This shows that students are interested in reading tissue culture textbook based on scientific literacy. The tissue culture textbook based on scientific literacy that have been developed can increase the level of scientific literacy, and the material presented is less monotonous and more innovative.

The feasibility of the textbook based on the validity requirements according to material experts, learning design experts, layout design experts, responses from lecturer of tissue culture courses and student responses shows that this textbook has a score in the very worthy category with an average percentage of 93,44%. Furthermore, after obtaining the data and analyzing the results, it was stated that the tissue culture textbook based on scientific literacy were very suitable for use in learning.

With the good evaluation results of the validator's assessment, responses from lecturer of tissue culture course, and student responses, it can be concluded that the development of the tissue culture textbook based on scientific literacy on the topic of in vitro plant breeding can increase students' curiosity and help facilitate students in studying tissue culture.

Conclusion

This development research resulted a product in the form of Tissue Culture Textbook based on Scientific Literacy using the Dick and Carey development model on the topic of In Vitro Plant Breeding. It can be concluded that the development of teaching material of in vitro plant breeding based on scientific literacy with a feasibility level based on material expert validation obtained a percentage of 91% in the very worthy category, learning design expert validation obtained a percentage of 95% in the very worthy category, layout design expert validation obtained a percentage of 99,2% in the very worthy category, response from lecturer of tissue culture course obtained a percentage of 95% in the very worthy category, and student responses obtained a percentage of 87% in the worthy category. Based on the findings that have been described in the conclusions of the research results, some suggestions that can be submitted in this study are tissue culture textbook based on scientific literacy was prepared based on a survey of student needs and has been validated by material, learning design, and layout design expert, so that the book can be printed to be used as a companion/ additional book in tissue culture learning. For further researchers, it is necessary to test the effecriveness of the tissue culture textbook based on scientific literacy that have been developed for students who are the main targets of the book.

Acknowledgment

The author would like to thank the thesis supervisor, the validators (material expert, learning design expert, layout design expert), respondent lecturer, and respondent students who have contributed to the implementation of this research.

References

Abdurrahman, Romli, S., Distrik, I. W., Herlina, K., Umam, R., Ramadhani, R., & Sumarni, S. Development and Validation of Open Ended Based on Worksheet for Growing Higher Level Thingking Skills of Students. *European Journal and Educational Research*, 9(2), 445-455.

Amalia, S. (2009). Analisis Buku Ajar Biologi SMP Kelas VIII di Kota Bandung berdasarkan Literasi Sains. *Skripsi: Tidak Diterbitkan*.

Ardhana, I. W. (2002). Konsep Penelitian Pengembangan dalam Bidang Pendidikan dan Pembelajaran. *Makalah* disampaikan pada Lokakarya Nasional Angkatan II Metodologi Penelitian Pengembangan Bidang Pendidikan dan Pembelajaran. 22-24 Maret.

Ayuhanna, I. (2015). Pengembangan Ensiklopedia Hidrokarbon dan Minyak Bumi sebagai Sumber Belajar Mandiri. *Skripsi*. Pustaka Pelajar.

BSNP. (2008). *Pedoman Penyusunan Kurikulum Tingkat Satuan Pendidikan Jenjang Sekolah Dasar.* Badan Standar Nasional Pendidikan.

Darliana. (2011). Pendekatan Fenomena Mengatasi Kelemahan Pembelajaran IPA. [Online]. http://www.p4tkipa.org/.

Firman, H. (2007). *Laporan Analisis Literasi Sains Berdasarkan Hasil PISA Nasional Tahun 2006*. Pusat Penilaian Pendidikan Badan Penelitian dan Pengembangan Departemen Pendidikan Nasional.

Gagne, R. M., & Briggs, L. J. (1979). *Principle of Instructional Design*. Holt Rinehart and Winston.

Hanafi. (2017). Konsep Penelitian R&D dalam Bidang Pendidikan. *Jurnal Kajian Keislaman*, 4(2), 129- 149.

Harahap, F. (2008). Penguasaan Kompetensi Teknologi Kultur Jaringan untuk Pengembangan Kewirausahaan Lulusan Biologi Unimed. *Jurnal LPM UNIMED*, 14(53), 44-51.

Harahap, F. (2010). Pembuatan dan Penerapan Media Animasi sebagai Upaya untuk Meningkatkan Kompetensi Mahasiswa Biologi pada Materi Kultur Jaringan. *Jurnal Pendidikan Biologi*, 1(3), 161-171.

Harahap, F., Nasution, N. E. A., & Manurung, Binari. (2019). The Effect of Blended Learning on Student's Learning Achievement and Science Process Skills in Plant Tissue Culture Course. *International Journal of Instruction*, 12(1), 521-238.

Harahap, S. R., Harahap, F., & Hasruddin. (2016). Pengembangan Bahan Ajar Mikrobiologi Pangan Berbasis Masalah. *Jurnal Pendidikan Biologi*, 5(3), 187-192.

Hayat, B. (2003). *Kemampuan Dasar Hidup: Prestasi Membaca, Matematika, dan Sains Anak Indonesia usia 15 tahun di Dunia Internasional*. Pusat Penilaian Pendidikan.

Khabib, N., Majdi, H., & Su'ad. (2021). Development of Social Science Teaching Materials by Using a Scientific Approach Based on the Surrounding Environment in Grade IV Studemts of SD 1 Jati Kulon. *Journal of Physics: Conference Series*.

Komalasari, K. (2014). *Pembelajaran Kontekstual Konsep dan Aplikasi*. PT Refika Aditama.

Kurniawati, I., & Rahayu, E. S. (2014). Pengembangan Media "Woody Puzzle" untuk Meningkatkan Motivasi, Aktivitas dan Hasil Belajar Siswa Materi Struktur Jaringan Tumbuhan. *Unnes Journal of Biology Education,* 3(3): 291-296.

Navy, A. (2013). Manajemen Sumber Belajar dalam Meningkatkan Mutu Pembelajaran Sains. *Jurnal Pendidikan Humaniora*, 1(4), 388-395.

Nurhamid, H., Murtono, & Utaminingsih, S. (2021). Development of Social Studies Teaching Materials Based on Local Wisdom of the Samin Society Class V Elementary School. *Journal of Physics: Conference Series.*

OECD. (2003). *The PISA 2003 Assessment Framework-Mathematics, Reading, Science and Problem Solving Knowledge and Skills*. OECD.

Primiani, C. N. (2014). Pengembangan Buku Ajar Berbasis Penelitian Bahan Alam Lokal sebagai Estrogenik pada Mata Kuliah Fisiologi Hewan. *Proceeding Mathematic and Science Forum 2014*, 5, 407-510.

Purnomo, & Mulyadi, E. (2006). Pengembangan Buku Teks Bahasa Indonesia SMP Berdasarkan Pendekatan Kontekstual. *Forum Kependidikan*, 26(1), 35-55.

Riadiyani, E. (2009). Analisis Buku Ajar Biologi SMA Kelas XI di Kota Bandung berdasarkan Literasi Sains. *Skripsi: Tidak Diterbitkan*.

Riyanto, A. (2013). Pengembangan Buku Pengayaan Keterampilan Membaca Bahasa Indonesia yang Bermuatan Nilai Kewirausahaan. *Jurnal Seloka*, 2 (1), 27-32.

Sanjaya, W. (2016). *Strategi Pembelajaran*. Prenadamedia Group.

Sudiyono, Musyono, A. D., Sunyoto, & Khoiron, A. M. (2020). Development of Teaaching Materials for Gas Metal Arc Welding (gmaw) Practice Courses. *Journal of Physics: Conference Series*.

Suprapto, K. A., Serevina, V., & Marpaung, M. A. The Developmentof Electronic Module Based on Problem Based Learning on Balance and Rotation Dynamic Topic to Improve Science Literacy of Senior High School Students. *AIP Conference Proceedings*.

Suwarni, E. (2015). "Pengembangan Buku Ajar Berbasis Lokal Materi Keanekaragaman Laba-laba di Kota Metro sebagai Sumber Belajar Alternatif Biologi untuk Siswa SMA Kelas X". *Jurnal Pendidikan Biologi*, 6(2), 86-92.

Tarigan, H. G., & Tarigan, D. (1993). *Telaah Buku Teks Bahasa Indonesia*. Angkasa.

Trisnayanti, Y., Ashadi, Widha, & Masykuri, M. (2021). Profile of Junior High School Science Textbooks: Fullfillment of the Higher-Order Thinking Skills Component. *Journal of Physics: Conference Series*.

Wibowo. (2016). *Manajemen Kinerja Edisi Kelima*. PT. Raja Grafindo Persada.

Yusuf, S. (2003). Literasi Siswa Indonesia Laporan PISA 2003. Pusat Penilaian Pendidikan. [Online]. http://www/p4tipa/org/ .

Zulpadly, Harahap, F., & Edi, S. (2016). Analisis Kesulitan Belajar Siswa Materi Bioteknologi SMA Negeri Se-Kabupaten Rokan Hilir. *Jurnal Pendidikan Biologi*, 1(6), 242-248.