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DEVELOPMENT OF TISSUE CULTURE TEXTBOOK BASED ON PROJECT BASED-LEARNING TO IMPROVE SCIENCE PROCESS SKILLS OF BIOLOGY DEPARTMENT STUDENTS UNIVERSITAS NEGERI MEDAN

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ABSTRACT: *The research on the development of this textbook was carried out based on the results of the analysis of student needs, namely that there are no teaching materials that can improve students' science process skills in the Tissue Culture course at the Department of Biology, State University of Medan. This textbook is compiled based on the learning syntax of Project-Based Learning (PjBL). This study aims to develop a Project-Based Learning-based tissue culture textbook to improve students' science process skills. This research method uses the Research and Development (R&D) with Thiagarajan's 4D (Define, Design, Develop, and Disseminate). The population of this study was students of the Biology Department of Universitas Negeri Medan with a sample of 47 people who were given a PjBL-based tissue culture textbook. The results showed that (1) the textbooks have been tested for feasibility by material experts (87,73) (2) instructional design experts (92) with a very feasible category, (3) the response of tissue culture lecturers (92) and (4) students based on individual tests (95.1), small group tests (93,75), and limited group tests (90.02) with a very good category and (5) the results of the calculation of N-Gain for science process skills were obtained at 0.66 which is in the medium category.*
Keywords: *project-based learning, textbooks, science process skills, feasibility.*

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INTRODUCTION

The challenges of the 21st century require innovative thinking based on scientific thinking and scientific discovery. Therefore, in order to remain competent in facing global opportunities and challenges in the future, every individual is required to have adequate thinking including scientific knowledge, scientific skills, scientific process skills and scientific attitudes (Susilawati, 2017). The curriculum set in higher education in accordance with the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 3 of 2020 concerning National Standards for Higher Education is an independent curriculum and the approach used in this curriculum is OBE (Outcome Based Education). The

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development of OBE in the lecture process has an outcome aspect where students achieve attitudes, knowledge and skills to solve data problems.

In accordance with the RPS for the Plant Tissue Culture course in the Department of Biology, FMIPA, Medan State University, one of the basic competencies that students must have is being able to understand the concept and application of plant tissue culture in everyday life (Harahap, 2019). Tissue culture is also a course that applies scientific concepts. The concept of science is science that is produced from a series of scientific methods, which require scientific process skills to discover them (Hayati, 2017).

Science process skills are one of the competencies that students must have, especially in tissue culture courses. In accordance with the RPS for the Plant Tissue Culture course in the Department of Biology, FMIPA, State University of Medan, one of the basic competencies that students must have is being able to understand the concept and application of plant tissue culture in everyday life (Harahap, 2018). Tissue culture is also a course that applies scientific concepts. The concept of science is knowledge that is produced from a series of scientific methods, which requires scientific process skills to discover it (Hayati, 2017).

However, based on observations made by researchers by distributing initial science process skills tests consisting of 10 questions with 10 indicators for each question, the average KPS value was only 34.25 which was included in the less category (Mursali & Safnowandi, 2016). Where the communication indicator got the lowest average value of 1.83, followed by indicators using tools and materials 2.25, estimated 2.25, applying concepts 3.16, proposing hypotheses 3.25, planning experiments 3.58, interpreting 3.66, asking questions 3.85, classifying 5.08, and observing 5.33. Materials at the tissue culture stage and various techniques in tissue culture are quite complicated materials. By distributing questionnaires to biology students at Medan State University, the data obtained 51.7% of students found it difficult to learn the material on tissue culture stages and various techniques in plant tissue culture.

Based on the results of observations through interviews conducted with lecturers in the Tissue Culture course at Medan State University, the tissue culture course consists of 2 credits and there is no tissue culture laboratory. This is one of the causes of the low science process skills of students due to the lack of implementation of practicums in this course. In fact, with practicum activities, students can be more active in improving science process skills (KPS) indicators such as planning research, observing, formulating hypotheses, using tools and materials, interpreting data, communicating results, and submitting statements (Siswono, 2017). In addition, the teaching materials used by lecturers are tissue culture books that only contain general theories.

Based on the problems above, it can be identified that there is a need to develop teaching materials using a learning model that can improve science process skills. Of the many teaching materials available, it turns out that textbooks are a learning resource that is used by other than the teaching staff themselves. The use of teaching materials both in schools and universities is usually focused on books and is indeed one that can help in the learning process (Adabia, 2022). With textbooks, the results that will be achieved in the learning process in the form of

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knowledge, understanding, and abilities or skills can be realized properly. Textbooks have very unique and specific characteristics. Unique, meaning that textbooks can only be used for certain students in a certain learning process. Meanwhile, specific means that the contents of the textbook are designed in such a way that they only achieve certain goals for certain students (Astuti et al., 2023).

The developed textbook must be in accordance with the demands of the OBE (Outcome Based Education) Curriculum which requires the application of case methods and case projects. Therefore, in the development of this textbook, the basis of Project Based Learning (PjBL) is used. The Project Based-Learning (PjBL) learning model is an approach that allows students to work independently to build their knowledge in learning and realize it in real products, the results of which are then presented (Ladyana, 2014). The project-based learning model is considered one of the superior learning models in developing various basic skills that students must have, such as decision-making skills, creativity and problem-solving abilities (Abidin, 2014). The application of PjBL in textbooks is considered to be able to improve students' science process skills, this is in line with what Larashati et al (2023) said that the application of PjBL can improve science process skills. This is in line with what Guo (2012) stated, namely that PjBL refers to the constructivist framework so that it makes the teaching and learning process more active, meaningful, and can build the learning process.

Similar research on the development of PjBL-based books has also been conducted by Ate et al (2022) entitled "Development of PjBL-Based Textbooks with a STEM Approach to Improve Students' Conceptual Understanding of Static Fluid Material for Senior High School Grade XI", the results of this study concluded that PjBL-STEM-based textbooks can improve students' conceptual understanding by up to 87.95%. Then based on a study entitled "Project-Based on the Internet of Things to Improve Students' Science Process Skills" by Larashati et al (2023), the PjBL Model is able to improve SPS and the t-test shows the application of PjBL PjBL with IoT on unidirectional electro physics material. And based on a journal entitled "Development of Temperature and Heat Modules Based on Project-Based Learning to Improve Science Process Skills and Critical Thinking Skills for Senior High School Students" by Hasanah et al (2018) shows that physics modules based on project-based learning on temperature and heat materials are used properly, and physics modules can improve students' science process skills and critical thinking skills effectively.

The syntax of Project-Based Learning consists of (Start with the Essential Question, 2) Design a Plan for the Project, 3) Create a Schedule, 4) Monitor the Student and the Progress of the Project, 5) Assess the Outcome, 6) Evaluation of the Experience (Kemendikbud, 2014). By implementing all of this syntax in the textbook, it is expected that students' science process skills can be improved through project assignments in the book. The process skill indicators that need to be trained are observing, grouping, interpreting, predicting, asking questions, formulating hypotheses, planning experiments, using tools and materials, applying concepts, communicating. Thus, this PjBL-based textbook is designed in such a way as to improve the KPS of Biology Department Students at Unimed.

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From the results of the analysis of student needs, which were distributed by the author via google form, as many as 96% of students agreed that PjBL-based textbooks were developed to improve KPS. Thus, the purpose of the study was to develop PjBL-based textbooks in tissue culture courses on the material Introduction to Tissue Culture, Stages of Tissue Culture, and Various Techniques in Tissue Culture and to test the feasibility of PjBL-based tissue culture textbooks developed based on assessments by several experts.

METHOD

This type of research is a Research and Development (R&D) using the 4D (Four-D) model which is a learning device development model proposed by Thiagarajan et al. (1974) with research procedures in the form of define, develop, design and disseminate. This research has been carried out at the Department of Biology, Faculty of Mathematics and Natural Sciences, State University of Medan as a sample analysis of product needs. The product will be tested in the 2022 PSB B class consisting of 47 students in the tissue culture course.

At the define stage, problems related to tissue culture learning are identified by conducting interviews and needs analysis. At the design stage, namely the creation of a book draft by preparing the topic, instrument, and format of the book to be developed. At the develop stage, the developed book is validated by material experts, instructional design experts, and assessed by tissue culture lecturers, and students with field trials. At the disseminate stage, the developed book is tested for its effectiveness on Biology Department students.

Data analysis in this study consisted of validity data analysis by material experts and instructional design experts, data analysis of tissue culture lecturer and student responses using a Likert scale, and effectiveness test analysis using N-Gain. The Likert scale aims to provide a range of values with categories of not decent, less decent, proper, and very decent for books that have been validated by experts. The textbooks being developed can be assessed as appropriate if they are in the "Decent" and "Very decent" categories" according to Table 1 (Nurmalasari, 2016).

Table 1. Likert Scale Validity Test

Scale Range	Categories
25-43	Not decent
44-62	Less decent
63-81	Proper
82-100	Very decent

The next data analysis is based on student responses which are carried out based on field trials. The questionnaire scores obtained will be interpreted in several categories which can be seen in Table 2 (Sugiono, 2017).

Table 2. Likert Scale Response

Scale Range	Categories
90< AB ≤ 100	Very Good (AB)
80< B ≤90	Good (B)
70< C ≤80	Simply (C)
<70	Less (K)

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Then data analysis was carried out to see the effectiveness of the textbook. To determine the effectiveness of the textbook, science process skill were tested using posttest and pretest consisting of 10 essay questions which include 10 indicators of science process skills to determine the increase in students science process skills. The normalized N-gain formula is used in this research which can be seen below.

$$N - gain = \frac{Skor\ Postest - Skor\ Pretest}{Skor\ maksimal - Skor\ Pretest}$$

After that, data analysis will be carried out using the N-gain value category in Table 3 (Hake, 1998).

Table 3. N-Gain Formula Value Range

Score Normalized Gain	Criteria
N-Gain ≥ 0.7	High
0,3 ≤ N-Gain ≥ 0,7	Medium
N-Gain < 0.3	Low

RESULT AND DISCUSSION

The process of implementing research on the development of Tissue Culture textbooks based on Project-Based Learning begin with define stage. At the define stage, some of the analyses carried out are problem analysis, needs analysis, curriculum analysis, and learning objectives analysis. From the results of this stage, information was obtained that there were no Project Based Learning-based teaching topics that could help understand and improve students' science process skills. The textbook design can be seen in Figure 1.

Figure 1. Tissue Culture Textbook Design

The structure of the draft textbook consists of 1) Cover, 2) Foreword, 3) Table of Contents, 4) Chapter I: Introduction to Tissue Culture, 5) Chapter II: Stages in Tissue Culture, 6) Chapter III: Various Techniques in Tissue Culture), 7) Project, 8) Bibliography, 9) Glossary, 10) Author Biography, and 12) Back cover. This textbook is compiled based on the project-based learning syntax, namely start with the essential question where in each chapter in the book there are basic questions

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before starting a project, then design a plan for the project, create a schedule, monitor the students, assess the outcome, and evaluate the experience. In the book, each chapter also contains practice questions that are adjusted to the indicators of science process skills. After the design stage, the next stage is the develop stage that aims to create a revised textbook product based on input from experts.

Feasibility Test According to Topic Expert

Based on the assessment of the project-based tissue culture textbook by the topic expert. The project-based tissue culture textbook was assessed in terms of the suitability of the topic, the accuracy and precision of the topic, the systematic presentation of the topic, and PjBL learning presented in Table 4.

Table 4. Topic Expert Validation

Assessment Component	Score	Criteria
Topic Suitability	87,5	Very Decent
Accuracy and Accuracy of Topic	88,46	Very Decent
Systematic Presentation of Topic	83,33	Very Decent
PjBL Learning	91,6	Very Decent
Average	**87,73**	**Very Decent**

From the aspect of topic suitability, the textbook is categorized as decent with a percentage of 87,5 in the "very decent" category, this means that the textbook developed has a scope of topic that is in accordance with the CPMK (Course Learning Outcomes) in the Semester Learning Plan (RPS) based on the curriculum. One of the bases for the preparation of textbooks is the scientific foundation where the scope of the topic in the textbook must be adjusted to the scientific structure and course learning outcome objectives (CPMK) that have been determined (Kusuma & Rakhman, 2018). From the aspect of accuracy and accuracy of the topic, the textbook is categorized as decent with a percentage of 88,46 in the “very decent” this means that the topic in the textbook is developed in accordance with the correct data and facts, the references used are in accordance with the network culture references, and the topic is in accordance with technological developments, this is in accordance with what is stated by Trianto (2007) is one of the aspects that must be included in the textbook is the validity aspect, among the aspects of the validity of the content, namely books that are developed in accordance with strong theory and rationality.

Based on the systematic aspect of presenting the topic, the textbook is categorized as decent with a percentage of 83,33 in the “very decent” this means that the topic in the developed textbook is presented with a good sentence structure, words and phrases, so that it can help students in mastering the topic. If students can easily understand the content of the topic well, then the book has good quality and can help students in mastering the teaching topic (Rakhman and Kusuma, 2018). Based on the aspect of PjBL Learning, the textbook is categorized as very decent with a percentage of 91,6. The PjBL Learning model provides opportunities for students to conduct experiments independently or in groups. In this model, more emphasis is placed on various activities to produce products and develop students' skills in terms of analyzing, understanding, producing, and presenting works or

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products in various forms of presentation such as schematics, designs, reports, papers, and so on (Banawi, 2019).

Based on the results of the validation of topic experts, the project-based tissue culture textbook received a validity percentage value of 87.73. If adjusted to the table above, the percentage value is included in the interval of 82%-100% so that the project-based tissue culture textbook in terms of presentation topic is feasible and valid to use.

Feasibility of Design Instructional Expert

Based on the assessment of the project-based tissue culture textbook by an instructional design expert that the project-based tissue culture textbook is assessed in terms of the feasibility of presentation, language, cover design, book content design, and the use of terms and symbols presented in Table 5.

Table 5. Design Instructional Expert Validation

Assessment Component	Score	Criteria
Eligibility of Presentation	85	Very Decent
Linguistics	88	Very Decent
Cover Design	100	Very Decent
Book Content Design	85	Very Decent
Use of Terms and Symbols	100	Very Decent
Average	**92**	**Very Decent**

In terms of presentation eligibility indicators, this textbook is categorized as very decent with a score of 85. This shows that the textbooks developed are decent in terms of presentation, both systematics and structure. In addition, the pictures and tables presented are equipped with descriptions and page numbers on each chapter and sub-chapter in accordance with the pages in the table of contents, a list of pictures and a list of tables. Teaching topics that are suitable for use with good criteria if the teaching topics are written using good and easy-to-understand language, presented attractively with pictures and descriptions (Syifaiyah et al., 2022).

In terms of language, this textbook is categorized as very decent with a score of 88. This shows that the developed textbook is decent in terms of language which includes sentence structure, spelling, terminology, and grammar in the book in accordance with PUEBI. That one of the bases for the preparation of textbooks is the basis of the readability of the topic where the order of sentences, words and phrases also determines the textbook, the language system and sentence structure that is structured and effective will create a good quality textbook (Kusuma & Rakhman, 2018).

In terms of cover design, this textbook is categorized as very decent with a score of 100. This shows that the textbook developed has a cover design that attracts the attention of readers, the layout of the front and back covers is appropriate, the type and size of the letters used are appropriate, elements such as symbols and images are proportional, the illustrations used already describe the content of the book, and the colors used are comfortable to see, this is in accordance with stated by Hernowo (2004) that a well-arranged and proportional book cover, having a

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synergistic element between words and pictures, gives more effect than a book design that consists only of text and is disproportionate (Nugraha & Syafi'ah 2020).

In terms of book design, this textbook is categorized as very decent with a score of 85. This shows that the design of the content of the book has been able to attract the attention of readers, especially students so that it can be used practically in helping mastery of the topic. In the design of the book, the type and size of the letters used are appropriate and easy to read. Divan (2018) stated that the use of font size for text must be adjusted to the characteristics of students as product users.

In terms of the use of terms and symbols, this textbook is categorized as very worthy with a value of 100. This shows that the terms and symbols presented in the book are accurate and easy to understand. The aspects of language feasibility in BSNP (2014) include suitability with student development, readability, motivational ability, straightforwardness, coherence and collapse of the flow of thought, conformity with Indonesian rules, and the use of the term symbol or symbol (Kriswanto & Rochmawati, 2020).

Based on the results of the validation of instructional design experts, the project-based tissue culture textbook received a validity percentage value of 92%. If adjusted to the table above, the percentage values are included in the interval of 82-100% so that the project-based tissue culture textbook in terms of instructional design is feasible and valid to use.

Tissue Culture Lecturer Responses to The Textbook

The assessment aspect of tissue culture responses consists of the aspect of the view of textbooks, topics, and PjBL (Project Based Learning) learning components) which can be seen ini Table 6.

Table 6. Culture Tissue Lecturer Response

Assessment Component	Score	Criteria
Textbook View	87	Good
Presentation of Topic	90	Very Good
PjBL (Project Based Learning) Learning Components	100	Very Good
Average	**92**	**Very Decent**

Based on the results of the response to the textbook by the tissue culture lecturer, an average rating of 92% was obtained with very good criteria. The results of this response show that in terms of the appearance of textbooks, topics, and PjBL-based learning components, lecturers consider that the textbooks can be used in the field as a learning resource for students in the learning activities of network culture courses.

Field Trial of Student Responses

At this stage, a response field test was carried out on students, carried out by individual tests on 3 students, small group tests on 9 students and limited group tests on 45 students. This trial consists of 3 aspects, namely: book view, presentation of book content, and PjBL (Project Based Learning) based learning component. A comparison of the average percentage of student responses to individual tests, small group tests and limited group tests can be seen in the Figure 2.

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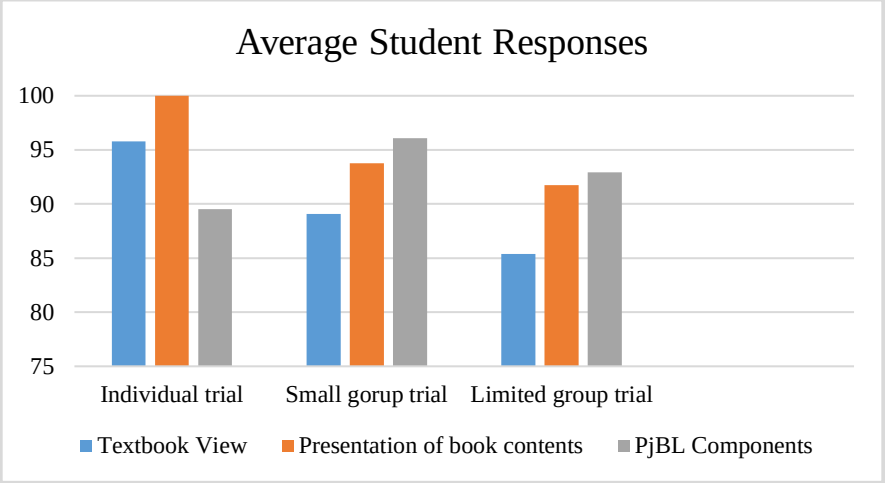
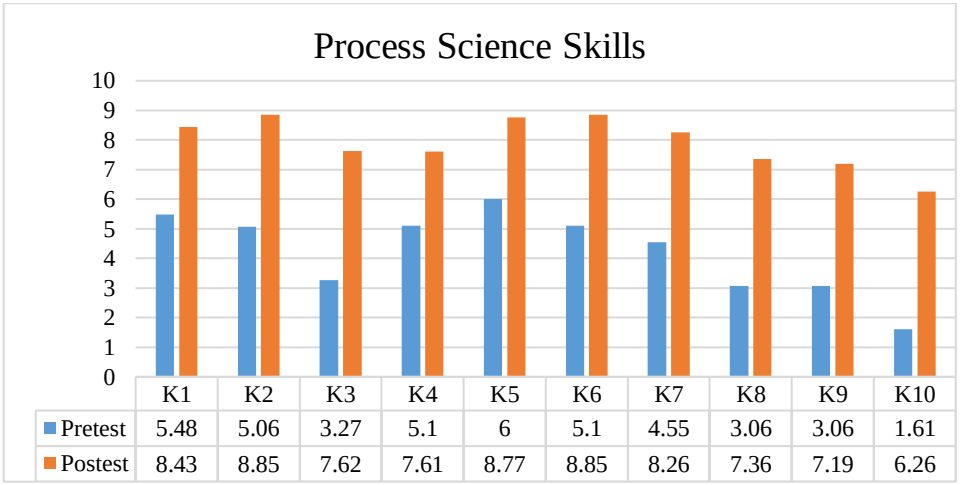


Figure 2. Average Field Trial of Student Response

The field trial in a small group consisting of 9 students obtained a score of 93,75 with a very good category. Meanwhile, from a limited group consisting of 45 students and obtained an average score of 90,02 with a very good category.

Effectiveness of Tissue Culture Textbook Based on Project-Based Learning

The dissemination stage began by providing pre-test and post-test questions to 47 Unimed Biology students of the 2022 PSB class B. Pre-test was carried out before reading textbooks and doing projects. The pre-test and post-test consist of 10 essay questions with each indicator of science process skills, namely K1= observing, K2= grouping, K3= interpreting, K4= forecasting, K5= asking questions, K6= formulating hypotheses, K7= planning experiments, K8= using tools and topics, applying concepts, and communicating.



	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10
Pretest	5.48	5.06	3.27	5.1	6	5.1	4.55	3.06	3.06	1.61
Postest	8.43	8.85	7.62	7.61	8.77	8.85	8.26	7.36	7.19	6.26

Figure 3. Pre-Test and Pos-Test Results of Science Process Skills PSB 2022 B

Based on the graph in the figure 4.3, the observing indicator with an average score of 5.48 for the pre-test and 8.43 for the post-test. Students are asked to look for differences in the characteristics of the two explants and explain the causes. This allows students to answer questions only by observing explant images that have

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previously been observed directly. With this indicator increasing, it shows that students can use their five senses well (Ichwanah & Nurita, 2019).

And the second indicator, the grouping/classifying indicators with an average pre-test 5.06 and post-test 8.85. This is because during project/practicum activities, students are used to looking for differences and grouping objects, so that in working on problems, students can easily determine similarities, differences, and contrast characteristics, especially in the topic of various techniques in tissue culture. Students were able to recognize the differences in the characteristics of tissue culture techniques from one to another after reading the textbook. The large percentage of grouping compared to other skills is caused by students' habits in looking for differences and grouping similarities in the objects observed (Rani, 2019).

The third indicator, interpreting with an average score of 3.27 for the pre-test and 7.62 for the post-test. These results show that students' skills in interpreting observation results have improved. In this aspect, the questions presented are in the form of diagrams of tissue culture observation results and students are asked to interpret and draw conclusions from the observation results. Although there are still some students who have not been able to answer this question, most of them have improved. Therefore, students are asked to practice more in translating scientific events and strengthening observation skills. With good observation skills, the skills in interpreting data will also be good (Khairunnisa et al., 2020).

The forth indicator, predicting with an average score of 3.27 for the pre-test and 7.61 for the post-test. These results show that students' skills in predicting/forecasting have improved. Most students have been able to apply concepts well so that they are able to predict what will happen. In the question, students were asked to predict what would happen to the explant if given too high a concentration of sterilant. Students have been able to answer this question because in the application of learning using PjBL-based textbooks, students have been asked to practice directly the stages of explant sterilization. Forecasting indicators are very important to apply because these skills can anticipate or make predictions about everything that will happen in the future, based on forecasts, relationships between facts, concepts, and scientific principles (Fitriana et al., 2019).

The fifth indicator, asking questions with an average score of 6 pre-test and 8.77 post-test. This shows that students already have the skills to ask questions based on research examples in the questions. Some of the questions asked by students have reached the C3-C6 cognitive type. Examples of questions such as "How does ZPT affect orchid growth?", "What ZPT has a big influence on orchid growth rate?", and "How active is ZPT in triggering orchid growth rate?". The skill of asking this question is also seen when students carry out project/practicum activities in the Laboratory. Students ask a lot of questions about what they find in the laboratory, or when they experience difficulties related to the orchid initiation practicum procedure. The ability to ask questions must be trained more often to foster students' skills in critical thinking. Questioning skills are one of the science process skills that are mandatory or need to be trained and habituated because when a person is used to asking questions, he will later have good abilities and can improve the ability to think critically (Nugraha et al., 2019).

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The sixth indicator, formulating a hypothesis with an average pre-test 5.1 and the post-test 8.85. The improvement in this indicator shows that students have been trained in making hypotheses. If the achievement of science process skills in formulating hypotheses means that students are already able to make predictions about the results of experiments based on their knowledge (Yanti et al., 2020).

The seventh indicator is the indicator of planning an experiment with an average score of 4.55 for the pre-test and 8.26 for the post-test. The skill of planning experiments increases because students can play an active role in learning activities while using project-based tissue culture textbooks, especially when carrying out orchid initiation projects. This experimental design skill needs to be improved again because it is one of the skills that must be possessed by biology students because experimental activities can be carried out well when students can also design experiments properly and correctly (Mutmainnah et al., 2019).

The eight indicator is using tools and materials, with an average score of 3.06 for the pre-test and 7.36 for the post-test. These results show a significant improvement in indicators using tools and topics. In this indicator, students were asked to explain the reason why they chose the end of the carrot cut with a size of 1x1x1 cm on the carrot explant in tissue culture. After using PjBL-based textbooks and doing practicums, most students can answer these questions because they have used tools and topics while in the laboratory directly. To be able to have skills in using tools and topics, students must use tools and topics directly in order to gain direct experience (Khairunnisa et al., 2020).

The ninth indicator is applying the concept with an average preteset score of 3.06 and a post-test score of 7.19. This shows that students are able to use concepts according to their experience. In the question, students were asked to explain the reason for the contamination of an explant. Based on the theory learned from the PjBL-based book and the projects implemented, students have studied and seen firsthand the contamination of the explant so that they can find out the cause of the contamination. Indicators of applying concepts are also very important, especially in tissue culture courses. It takes an understanding of the concepts of the applied sciences to be able to understand tissue culture. This is the problem for students, the lack of understanding of the basic concepts of the applied sciences to tissue culture and the lack of availability of supporting learning resources make it difficult for students to understand tissue culture material (Harahap, 2020). Students have improved in the indicator of applying concepts, which means that students are skilled in solving problems in problems using their knowledge or concepts (Effendi et al., 2018). Therefore, students have been able to find answers or solutions to new problems, namely by applying their knowledge (Rahayu, 2020).

The tenth indicator is communicating with an average score of 1.61 for the pre-test and 6.36 for the post-test. In this study, students were asked to convey the results of the experiment in the form of graphs by describing them in a narrative. Although there are still some students who are unable to answer this question, most of them have been able to answer it to conclude the results of the experiment. In communicating indicators, students must be able to read and present information accurately, for example by creating and reading graphs, diagrams, or tables (Rani, 2019).

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The N-gain test aims to determine the effectiveness of the textbooks developed in improving science process skills about tissue culture, especially in the introduction of tissue culture, tissue culture stages, and various techniques in tissue culture.

Table 7. N-Gain Result of Science Process Skills Test

Score	Amount	Presentation	Criteria
N-Gain ≥ 0.7	26	55,31%	High
0,3 ≤ N-Gain ≥ 0,7	21	44,68%	Medium
0,3 ≤ N-Gain ≥ 0,7	0	0%	Low

Based on the results of the calculation of the N-Gain test, it shows that most students have an average N-Gain score of >0.7, which is as many as 20 people, then the average N-Gain value for the PSB 22 B class is 0.66 or 66% which is in the "medium" category where the category is almost heading towards the "high" category. Based on the N-Gain score, it can be concluded that the PjBL-based tissue culture textbook that has been developed is quite effective in improving students' science process skills. This is in accordance with what Novita et al (202 4) stated that science process skills can be developed not only by applying the PjBL model but also teaching topics and media that are in accordance with the learning model. This is also in accordance with the statement of Pratiwi et al (2014) that the use of textbooks can support and attract interest and motivate students and provide a positive influence in developing students' scientific attitudes in improving learning outcomes to be better. During the learning process, there was an increase in students' activeness in asking questions about the project to be carried out, the mathematical calculation process, and students actively answering questions and giving opinions. Project Based Learning is able to improve students' science process skills because in its application students will be required to be able to make research plans, record findings, debate, discuss, and make decisions (Bariyah & Sugandi, 2022).

CONCLUSION

Based on the results of validation by material experts and instructional design experts, the response of tissue culture lecturers, as well as field trials with individual trials, small group trials, and limited group trials, the Project-Based Learning-based tissue culture textbook can be used as a learning resource and implemented in learning for students of the Department of Biology, State University of Medan.

RECOMENDATION

It is recommended that the assessment by expert validators be carried out by at least two teams of experts so that there is a comparison of the results of the assessment of the developed product and in order to get maximum result, it is recommended that at the stage of product effectiveness testing, it should be carried out more complex and with a wider sample.

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