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Development of project based biotechnology teaching books

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ABSTRACT

Various research states that one of the causes of misconception is textbooks or printed media that are used as learning resources. This is because the textbooks developed are monotonous and tend to present theories in full without practicing skills or stimulating the ability to think and solve problems. The aim of this research is to develop project-based biotechnology textbooks. This certainly can answer the demands of higher education in the era of industrial revolution 4.0 where learning should be able to empower cognitive, process skills, social skills, system skills, complex problem solving and others. The depth of the material and projects selected for each topic is seen with the results of the analysis of conceptual mastery and misconceptions found. The hope is that this project-based textbook can overcome these problems. The research methodology used is 4-D development research. The 4-D development research method consists of 4 main stages, namely: define, design, develop and disseminate. The subjects of the field trials were 30 biology education students at STKIP Persada Khatulistiwa Sintang. The percentage of validation results for project-based biotechnology textbooks by material experts, media experts, and biotechnology lecturers is 3.75 so that the textbooks have very decent qualifications. The percentage of project validation results was 3.32 with the feasible category. This textbook was tested on biology education students at the initial development testing stage. The effectiveness of this textbook is seen from the gain score of 0.54 with moderate criteria, so that it can be declared effective enough.



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INTRODUCTION

Learning is not a routine and rigid activity. However, it is a dynamic, creative, innovative, flexible and progressive process. Routine and rigid learning will produce monotonous, deterministic or fatalistic learning. Learning like this has an impact on the low quality of learning, both in terms of process and results. From the aspect of the process, this learning does not involve students in learning activities, both inside and outside the classroom. In a position like this, students are seen as learning objects not as learning subjects who should be actively involved in learning activities. One thing that affects the learning process is the use of learning resources that can support the learning process.

The learning resources developed are expected to be able to train students to develop their potential and be actively involved in the learning process such as doing assignments, practice questions, discussions, case studies, and practicum. So that students do not only learn in one direction by hearing what is conveyed by the teacher or lecturer which will have an impact on boredom in learning and become a cognitive burden but can be actively involved in learning (Duda, 2017)

One learning that connects knowledge and skills is a project-based learning model. According to Doppelt (2003) the project-based learning model is a method based on constructivism that supports the involvement of learners in problem-solving situations. The project-based learning model is able to improve the skills of students in managing various sources because students must be able to find resources for the completion of the project they are working on.

The learning process in tertiary institutions must also be supported by adequate learning resources. According to the Law of the Republic of Indonesia Number 12 of 2012 concerning Higher Education Article 41 Paragraph 1 also mandates that learning resources in the higher education environment must be provided, facilitated, or owned by tertiary institutions in accordance with the study program being developed. One type of printed learning resource that is often used in the learning process is textbooks. By using textbooks, learning can run effectively and efficiently because in the textbook contains a set of subject matter materials arranged systematically showing the integrity of the competencies that will be mastered by students in learning activities.

In higher education, textbooks are prepared to assist lecturers and students in lectures. However, based on the observations of researchers, it is known that STKIP Persada Khatulistiwa Sintang, Indonesia still experiences limited learning resources needed by students, one of which is the availability of textbooks and learning resources that have a tendency of textbooks to be theoretical studies or reference books so that they are not able to empower students' abilities. Under these conditions, researchers felt the need to develop project-based textbooks for biotechnology courses.

Teaching materials are an important component in learning. According to Hamalik (2009) learning is a modification or reinforcing behavior through experience (learning is defined as the modification or strengthening of behavior through expriencing). Furthermore, Prastowo (2015) states that teaching materials are anything (can be objects, data, facts, ideas, people, etc.) that can lead to a learning process. Cobanoglu & Sahin (2009) revealed that the analyzed biology textbooks showed that there were important errors/misconceptions in the textbooks and also did not provide inquiry questions and the approach taken was still in the form of rote memorization. Therefore, researchers want to develop project-based textbooks that involve student activities to work on projects in the form of questions so that they can empower students' cognitive abilities to solve problems, think critically, creatively and understand the material in the book well and can easily apply it. or relate to everyday life.

Teaching materials consist of two words, namely teaching and materials. According to Daryanto and Dwicahyono (2014), teaching materials are information, tools and texts needed by teachers for planning and studying the implementation of learning. Teaching materials are learning resources that are easy to find and use. This teaching material has directions and pictures that make it easier for students to read and understand the material set forth in the book, no other special skills needed, only teacher guidance is needed to use textbooks. Teaching materials are said to be good, if (1) the material or content coverage is in accordance with the curriculum, (2) the presentation of the material meets the principles of learning, (3) good language and readability, and (4) the format of books or graphics is attractive. The criteria for good teaching materials teaching materials given to students must be quality teaching materials. Quality teaching materials can produce quality students, because students consume quality teaching materials (Daryanto, 2013). Laksana & Wawe (2015) show that student learning activities increase accompanied by a strengthening of understanding of science concepts after



learning is carried out with the help of learning sources or media. A good textbook is able to connect every material with scientific research as well as science, technology, and society by highlighting how aspects of science are carried out and the role of science in life (Udeani, 2013).

The results of research from Chiapetta (1991) suggest that existing science books emphasize more on scientific knowledge. There are four categories of scientific literacy, the first is scientific knowledge. Relating to facts, concepts, laws, principles, theories, models, hypotheses. Second, the investigation of the nature of science. Relating to the stimulation of thinking and doing for investigation. This category assigns students to make observations, measure, draw conclusions, record data, perform calculations, and conduct experiments. Third, science as a way of thinking to describe how scientists find knowledge. It has to do with thinking, reasoning, reflection. Fourth, the interaction of science, technology and society. Relating to the depiction of the effects or impacts of science and society.

Based on the results of observations of biology education students at STKIP Persada Khatulistiwa Sintang, that learning has not been very effective where the use of conventional learning strategies or lectures causes the learning process to not run well or boring. In addition, the teaching materials used are inadequate for teaching biotechnology material where it is known that biotechnology materials are difficult or there are many abstract concepts. Learning that is carried out cannot develop the potential of the students and students do not understand or understand the material provided. Therefore, researchers need to develop project-based biotechnology textbooks so that they can help streamline learning for biology education students at STKIP Persada Khatulistiwa Sintang.

METHODS

Research Design

The method used in this research is development research. The development research chosen was the 4-D (four D) model where this development research was developed by Thiagarajan et al. (1974). The 4-D development research consists of 4 main stages, namely: Define, Design, Develop and Disseminate. The research and development aims to produce a product in the form of a project-based biotechnology textbook. The product developed is then tested for its feasibility with validity and product testing to determine the feasibility of the product in the effectiveness of learning in biology education students at STKIP Persada Khatulistiwa Sintang with the One-Group Pretest-Posttest Design research design (Sugiyono, 2016).

Population and Samples

The population in this study were biology education students at STKIP Persada Khatulistiwa Sintang who have been and are currently taking biotechnology courses. The trial subjects in this textbook development research consisted of small group trial subjects and field trials. The small group trial was carried out on 9 biology education students at STKIP Persada Khatulistiwa Sintang. The subjects of the field trials were 30 students of STKIP Persada Khatulistiwa Sintang biology education.

Instrument

The data collection instrument used in the research on the development of project-based biotechnology textbooks was expert validation sheets for both lecturers and students which includes substance, construction, material and language. Student readability questionnaires, learning device validation sheets, and cognitive learning outcomes tests in the form of essay test questions to see an increase in cognitive learning outcomes after extensive textbook use trials.

Procedure

In this study, the teaching material development procedure consisted of: (1) the needs analysis stage consisting of front end analysis about learning resources for biotechnology, learner analysis, task analysis, concept analysis about biotechnology material, and specifying instructional objectives (learning objects). Specific in biology education students; (2) the design stage consists of four activities, namely: constructing criterion-referenced tests, media selection, format selection, initial design; (3) the development stage consists of two activities, namely: expert appraisal and



development testing; (4) the product trial project-based biotechnology book products stage is carried out on biology education students of STKIP Persada Khatulistiwa Sintang.

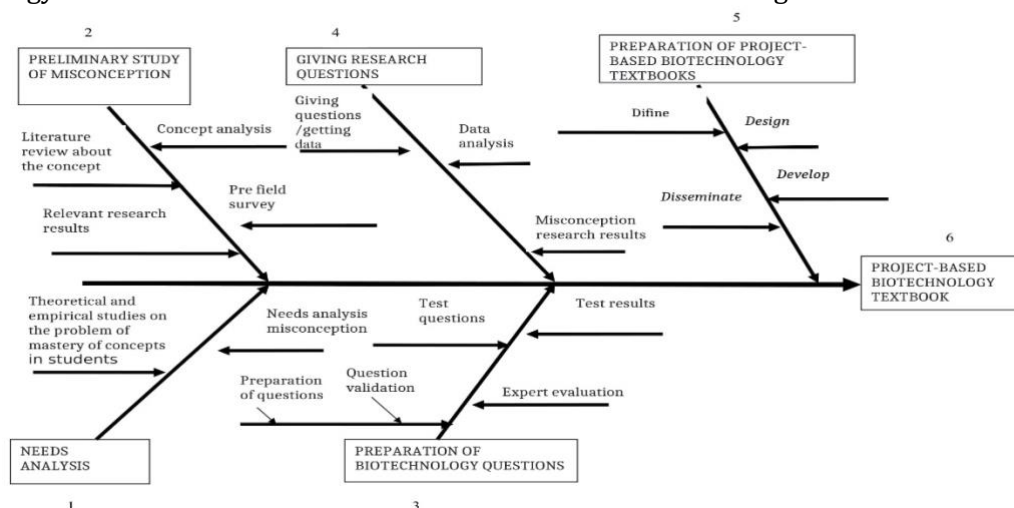


Figure 1. Textbook Development Procedure

Data Analysis Techniques

The data analysis technique used in this development research is to assess the quality of teaching materials developed. Assessment of the quality of teaching materials includes:

- Data analysis for validation of experts, educational practitioners and small group testing. The data obtained in this study were the results of the assessment by the validator that had been given. The answers to the validation sheet use the choice categories in Table 1 and the data on the results of the assessment of teaching material readability by the selected categories in Table 2.

Table 1.

Criteria for Validator Biology Teaching Materials

No	Scale	Description
1.	4	Very valid / very good / very interesting / very clear / very precise
2.	3	Valid / good / interesting / clear / precise
3.	2	Less valid / not good / less interesting / unclear / not quite right
4.	1	Invalid / not good / not interesting / unclear / inaccurate

Table 2.

Criteria for Readability of Teaching Materials

No	Scale	Description
1.	4	Strongly agree
2.	3	Agree
3.	2	Disagree
4.	1	Strongly Disagree

- Calculate the average value. Arikunto (2010) states that to determine the final score ranking for each research item, the number of scores obtained is divided by the number of respondents who answered the questionnaire. The mathematical function can be written as follows:

$$X = \frac{\sum x}{n}$$

Information:

X = average value

$\sum x$ = total score of the assessment

N = number of respondents



c. Determine the conclusions of each validated aspect, set the validation criteria for the feasibility level and product revisions as in [Table 3](#).

Table 3

Eligibility criteria and product revisions

No	Score	Description
1.	3.26-4.00	Very feasible, no need to revise Well worth it, no need to revise
2.	2.51-3.25	
3.	1.76-2.50	Not feasible, needs to be revised
4.	1.00-1.75	Not very feasible, needs to be revised

Qualitative data in the form of suggestions, criticisms and responses from respondents are used as a consideration in making revisions to the teaching materials developed. Testing of students' cognitive improvement after the learning process using student project-based biotechnology teaching materials was carried out using a gain score. The formula for standardized gain score is as follows.

$$\text{Gain} = \frac{\text{posttest mean score} - \text{pretest mean score}}{\text{maximum score} - \text{pretest mean score}}$$

The level of standardized gain score is categorized into three categories, namely high, medium, and low which are described in [Table 4](#).

Tabel 4

Criteria for standardized gain score

No	gain score results	Criteria
1.	gain > 0,7	High
2.	0,7 ≥ gain ≥ 0,3	Moderate
3.	gain < 0,3	Low

RESULTS AND DISCUSSION

In this study, researchers developed project-based biotechnology textbooks with other tools such as SAP, RPS and their instruments. The development method consists of 4 stages, namely define, design, develop and disseminate.

1. The define stage (definition)

At this stage, it is done to define the terms of development. In general, in this definition, development needs analysis activities are carried out, product development requirements that are in accordance with user needs and research models and are suitable for developing products. Analysis can be done through literature studies or preliminary research. There are 5 stages: front end analysis (comprehensive analysis), learner analysis (student analysis), task analysis, concept analysis and specifying instructional objectives (specific learning objects).

2. Design stage (design)

At this design stage includes the first, the preparation of tests (criterion-test construction), namely tests of cognitive learning outcomes and biotechnology material. Second, the selection of media and formats covering SAP design, RPS, subject matter, practice questions.

Third, the initial design, which includes the initial design in the form of a draft project-based textbook, a knowledge test, and a project-based textbook validation sheet. The developed project-based textbook contains biotechnology material.

3. The develop stage (development)

a. Result of Device Validation (Expert Appraisal)

Expert appraisal is a technique for validating or assessing the feasibility of a product design. In this activity, evaluation is carried out by experts in their fields. The suggestions given are used to improve the material and learning designs that have been compiled. Based on input from experts, the teaching materials were revised to make them more precise, effective, easy to use and of high technical quality. Expert validators consist of 2 lecturers of STKIP Persada Khatulistiwa Sintang, consisting of 1 lecturer of biology material and 1 lecturer of education experts.



The results of the assessment of the learning design expert validator, namely Mrs. Yuniarti Essi Utami, M.Pd; and Mrs. Leliavia, M.Pd on SAP learning is presented briefly in Table 5. Based on this table, it is known that the average score of SAP assessment by learning design experts and education practitioners is 3.24. These results indicate that the SAP developed is in the proper category and does not need to be revised in terms of learning design.

Table 5.
Recapitulation of syllabus validation results by the validator

No	Aspect	Average score	Category
1	Completeness of the Components (Format) of the Syllabus	3.25	Worthy
2	Subject learning outcomes	3.17	Worthy
3	Learning materials	3.00	Worthy
4	Learning Activities	3.11	Worthy
5	Indicators of Competence Achievement	3.19	Worthy
6	Assessment	3.15	Worthy
7	Time Allocation	3.58	Very Worthy
8	Learning Resources	3.40	Worthy
9	Grammar	3.17	Worthy
10	Benefits	3.33	Worthy
Average of All Aspects		3.24	Worthy

Summary of the results of the validation of the learning design expert on the RPS as presented in Table 6. In Table 6, it is known that the average score of the RPS assessment by learning design experts is 3.37. The results of the assessment indicate that the RPS developed is categorized as feasible in terms of learning design.

Table 6.
Recapitulation of RPS validation results by the validator

No	Aspect	Average score	Category
1	RPS components	4.00	Very Worthy
2	RPS identity	3.45	Worthy
3	Subject learning outcomes	3.50	Worthy
4	The final expected ability	3.23	Worthy
5	Material / subject	3.33	Worthy
6	Forms / Learning Activities	3.20	Worthy
7	Learning experience	3.13	Worthy
8	Assessment criteria	3.15	Worthy
9	Learning Resources	3.33	Worthy
10	Writing and Benefits	3.33	Worthy
Average of All Aspects		3.37	Worthy

b. Book Validation Results by Material Experts

The data obtained at the material expert validation stage are in the form of assessments, opinions, and suggestions regarding the suitability of the material contained in the developed textbook and ensuring that the material in the textbook is scientifically compiled correctly. The data presented below is the result of material expert's assessment of the developed biotechnology textbooks.

The results of the evaluation of the material expert validator, namely Dr. Yakobus Bustami, S.Si., M.Pd and Mrs. Yuniarti Essi Utami, M.Pd; and Mrs. Leliavia, M.Pd on biotechnology textbooks are briefly presented in Table 7. Based on this table, it is known that the average score of the material expert, design expert, and lecturer assessment for the module is 3.75. These results indicate that the developed project-based biotechnology textbooks fall into the very feasible textbook category.

Table 7

Validation Results of project-based biotechnology textbooks by the Validator

No	Aspect	Average score	Category
1	Suitability of Teaching Materials	4.00	Very Worthy
2	Serving Feasibility	3.32	Worthy
3	Graphic Worthiness	3.93	Very Worthy
4	Book Content Design	3.57	Very Worthy
5	Content eligibility	3.67	Very Worthy
6	Language	3.75	Very Worthy
7	Benefits	4.00	Very Worthy
	Average of All Aspects	3.75	Very Worthy

A summary of the results of the validation of material experts, design experts, on the appraisal instrument or project is presented in [Table 8](#). Based on this table, it is known that the average score of the assessment of the appraisal or project instrument is 3.32. These results indicate that the appraisal or project instrument developed is in the feasible category.

Tabel 8

Results of the Validation of the Appraisal Instrument or project by the Validator

No	Aspect	Average score	Category
1	Substance	3.58	Very Worthy
2	Construction	3.33	Worthy
3	Theory/material	3.21	Worthy
4	Language	3.17	Worthy
	Average of All Aspects	3.32	Worthy

4. Trial (Disseminate)

1). Small Group Trial Results (Initial Development Testing)

Small group trials or initial development testing in class A13 for students taking biotechnology courses against project-based biotechnology textbooks which aim to find out and correct the most conspicuous mistakes in textbooks such as typographical errors, typos, letter errors, and image errors. and assess the clarity of the content whether it is easy to understand, easy to understand, attractiveness of appearance and readability. This readability test was conducted on biology education students taking biotechnology courses.

Based on the results of the small group test of the complete textbook, it shows that the average score for the assessment of project-based biotechnology textbooks developed is 3.51. These results indicate that the textbook developed is in the very feasible category.

2). Large Group Test Results (Quantitative Development Testing)

A large group test was conducted to determine the effectiveness of the project-based biotechnology textbooks that had been developed. The large group test is carried out on biology education students who take biotechnology courses by applying learning using project-based textbooks.

The data from the large group test results presented are student learning outcomes regarding knowledge mastery. Mastery of knowledge can be seen based on the pretest and posttest of biology education students. The implementation of the pretest and posttest is carried out to determine the progress of student learning before and after learning with a scientific approach. Based on [Table 9](#), it shows that the average pretest and posttest on biotechnology material has increased by 27.09.

Table 9

Summary of Student Pretest and Posttest in Large Group Test

No.	Material	Average Score		
		Pretest	Posttest	
1.	Enhancement	Biotechnology	50,60	78,50
			27,09	

3). Result of Expert Appraisal Analysis



Expert Appraisal or expert validation in this analysis consists of validation of learning design experts, material expertise, and learning implementation. The following shows the analysis and validation results of learning design experts and material experts on project-based biotechnology textbooks that have been developed which include syllabus, RPS, projects, and project-based biotechnology textbooks. The results of the data validation analysis of the learning design expert and material expert are briefly shown in [Table 10](#).

Table 10

Results of Data Analysis Validation of Learning Devices by Media Experts, Material Experts

Module	Average	Qualification	Test Decision
SAP	3.24	Worthy	No Revision Needed
RPS	3.37	Worthy	No Revision Needed
Textbooks	3.75	Very Worthy	No Revision Needed
Project	3.32	Worthy	No Revision Needed

Based on these results, the overall results of the development of project-based biotechnology textbooks are in the feasible category, but there are some notes that need to be considered so that improvements need to be made based on the advice of learning equipment experts and material experts. The improvement aims to reduce fundamental errors related to material and structural aspects of the project-based textbook being developed.

The progress of learning competencies consisting of syllabus, RPS, Project. In essence, the preparation of project-based textbooks aims to design student learning experiences to achieve learning goals. The reason for the importance of making RPS is that it can help lecturers to prepare learning material before the lesson is taught so that learning difficulties can be predicted and solutions can be found.

4). Results of Small Group Test Analysis (Initial Development Testing) on Readability of biotechnology textbooks and projects

The small group test data on biology education students was carried out with 9 students, the result of the percentage of small group test data analysis was 80.50%. These results indicate that the project-based biotechnology textbooks developed include biotechnology textbook qualifications which are very feasible and do not need to be revised.

Analysis of the data generated in the readability test by students showed that the biotechnology textbook developed was suitable for use in learning. Project-based biotechnology textbooks are one of the written teaching materials that can help students in learning. Project-based textbooks are written teaching materials that are expected to support other teaching materials or lecturers' explanations.

5). Results of Data Analysis of Large Group Test (quantitative development testing) on cognitive learning outcomes

The large group test was carried out on biology education students with a total of 30 students. The results of data analysis presented are student learning outcomes in the realm of cognitive, skills, and attitudes. Learning outcomes regarding students' cognitive abilities can be seen based on the results of the pretest and posttest. There is a gain score on the biotechnology material of 0.54 in the medium category. The medium category in the gain score achieved by students through the pretest and posttest has increased. The gain score of 0.54 on the biotechnology material shows that this project-based textbook is effective for use in the learning process.



6). Product Revisions

Product revisions are carried out at each stage of expert appraisal and development testing. In the expert appraisal, revisions are made based on suggestions and criticisms from material expert validators, media experts, and subject lecturers. In development testing, revisions are made based on deficiencies during the implementation of learning. The revision of project-based biotechnology textbooks during the expert appraisal (expert validation) and development testing stages can be described as follows. Revisions to project-based biotechnology textbooks by material experts covering biotechnology textbooks are shown in [Table 11](#).



Table 11.

Module Revision Results at the Material Expert Validation Stage

No	Book section	Advice By Validators	Revision
1	Book cover	An abstract image	Change the cover title to be clear
2.	Picture	Before the revision	After the revision
			

DISCUSSION

Project-based textbook products developed are teaching materials that consist of: (1) syllabus, (2) RPS, (3) projects, (4) textbooks and (5) assessment instruments. The development process is carried out with a 4-D development model which consists of 4 main stages, namely: define, design, develop and disseminate (Thiagarajan, et al, 1974). This method was chosen because it aims to produce a product in the form of a project-based biotechnology textbook.

The final product in the form of a student project-based biotechnology textbook was generated from product revisions after the expert appraisal and development testing stages. The development of project-based textbooks is adapted to the sources that are often used for teaching in universities, research journals both nationally and internationally.

a. Lecture program unit/Satuan acara perkuliahan (SAP)

SAP is a learning plan in a group of certain subjects / themes that include developed competencies, course learning outcomes, subject matter / learning, learning activities, indicators, assessments, time allocation, and learning resources / materials / tools. The syllabus is a set of plans and arrangements for learning activities, class management, and assessment of learning outcomes.

The average result of SAP validation by material experts, media experts, and subject lecturers for SAP is 3.24, so it shows that SAP has a proper qualification. Revisions are made based on the validator's suggestions and input on SAP. In the product validation process, several revisions were made, namely in the learning media section, consistent use of writing and additions to the form of instruments.

Evaluation of the syllabus is an effort to ensure that the implementation of the syllabus is in accordance with the programs and conditions set out in the syllabus document. In the process, evaluation can be in the form of activities to revise, eliminate, modify, add or without changing the learning components based on data that can be used for evaluation purposes and by always paying attention to the results achieved based on competence (Firdaus, 2008). Several principles that must be considered in making lecture program units: relevance, effectiveness, efficiency, continuity, comprehension, and flexibility.

b. Semester learning plan/Rencana pembelajaran semester (RPS)

The semester learning plan (RPS) is a face-to-face learning activity plan for one or more meetings. RPS was developed from the syllabus to further direct the learning activities of students to answer the learning outcomes of the course.

From the data, the percentage of validation results by material experts, media experts and martakuliah lecturers on the RPS was 3.37, thus indicating that the qualifications of the RPS that had been developed were feasible. Revisions were made based on the validator's suggestions and input to the RPS.

According to Nasution (2017) learning planning is a systematic approach that includes analysis of learning needs, formulating learning objectives, developing learning strategies, developing teaching materials, and developing evaluation tools in an effort to achieve the expected learning objectives. Learning planning includes all processes carried out in the systems approach. Learning

theory, evaluation theory, learning theory are the theories that underlie learning planning (Walter & Lou, 2015).

According to Boak (1998) an effective RPS has two main characteristics (a) flexibility and (b) focus. Flexibility is being able to meet the various needs and learning styles of students. Focus is effective in helping students focus their attention on achieving specific / specific learning outcomes and outcomes. These two main characteristics are necessary for an effective learning contract. Without flexibility, most of the benefits of a study contract are not obtained, and without focus students are easily lost. Nurdyansyah (2018) explains that "The education world must innovate in a whole. It means that all the devices in education system have its role and be the factors which take the important effect in successful of education system".

c. Project

The projects contained in the project-based biotechnology textbook are in the form of group assignments, group discussions, and practice questions in the form of theory and their application. From the data obtained, the percentage of project validation results by material experts, media experts and subject lecturers for the project is 3.32, indicating that the project qualifications that have been developed are feasible. Revisions are made based on the requirements and input of the validator on the project.

According to Santi (2011) and Liu & Hsiao (2002) project-based learning can empower solid and meaningful-use knowledge and skills that are built through authentic assignments and work; broaden knowledge through authenticity curricular activities that are supported by the process of learning activities to plan or investigate; building knowledge through real-world experiences and interpersonal cognitive negotiations that take place in a collaborative work atmosphere. This is certainly in accordance with the demands of Higher Education in the era of the industrial revolution 4.0. The scientific approach makes it easier for students to understand the material presented and makes students more active (Purwaningsih, et al., 2014).

This project-based learning model is more focused on concepts that involve students in problem-solving activities and provide opportunities for students to work autonomously (Doppelt, 2005). Collaboration skills are skills to work together effectively and show respect for diverse team members, train fluency and a willingness to make decisions needed to achieve common goals (Greenstein, 2012). Scientific literacy in education is developing the ability to be creative, utilizing knowledge and skills in accordance with scientific evidence and scientific processes, especially with relevance in everyday life (Holbrook, 2009: 5). Guided inquiry is one of the most important learning components and is suitable for use in today's science learning reform because the model has the ability to solve problems and invite students to be directly involved in the scientific process (Wenning, 2011).

According to Frey, *et al* (2012) authentic assessments can support classroom instruction, gather evidence from multiple activities, generate learning and teaching among participants, and reflect local values, standards, and controls. Palm (2008) also concluded that authenticity is defined as a real assessment in terms of the process and the product of the assessment condition or context, and true for life outside of school, curriculum, and classroom practice or learning and instruction.

d. Textbooks

According to Daryanto & Dwicahyono (2014) "teaching materials are information, tools and texts needed by teachers for planning and studying the implementation of learning". Textbooks are teaching materials and learning resources that are easy to find and use, where students simply read and understand the material set forth in the book.

The average result of the validation of project-based teaching materials by material experts, media experts, and subject lecturers is 3.75 so that the teaching materials have very decent qualifications. Revisions are made based on the validator's suggestions and input on the textbooks being developed. Textbooks were tested on biology education students of STKIP Persada Khatulistiwa Sintang. The percentage of textbook assessments by biology education students is 88.43%. These results indicate that the textbooks developed are included in the qualifications of very feasible textbooks.

Material in biotechnology is abstract, and is usually presented through theoretical lectures, so that in its implementation it must be assisted by supporting textbooks so that students can understand the concepts and applications / practices in biotechnology material, and are also able to apply them in learning (Safitri, 2014). Therefore, researchers develop project-based biotechnology textbooks so that they can assist students in understanding biotechnology theory through the concepts and applications of the designed textbooks. According to Amirudin, (2015) project-based learning (project based learning model) has the advantage of its characteristics, namely helping students design a process to determine an outcome, training students to be responsible for managing information carried out on a project and finally students producing a real product student results itself which is then presented in class.

According to Hamalik, (2009) learning is "modifying or reinforcing behavior through experience (learning is defined as the modification or strengthening of behavior through experiencing)". Meanwhile, according to Karwono (2007), the learning process may be used singly or in combination, both planned learning resources and learning resources used ". Furthermore, Prastowo, (2015) said, learning resources are "everything (can be objects, data, facts, ideas, people, etc.) that can lead to a learning process". Teaching materials are useful to assist educators in carrying out learning activities. For educators, teaching materials are used to direct all their activities and what should be taught to students in the learning process (Nurdyansyah, 2018). Tiemensma (2009: 2). "said that reading is the most important component in the 21st century in order to survive in the current era of globalism. The success of students in participating in teaching and learning activities in schools is largely determined by their ability to read. As it is known that most of the knowledge is presented in the form of written language to require children to do reading activities in order to gain knowledge.

e. Assessment Instruments

The instrument is a measuring instrument used to collect data, it can be a test or a non-test. The test or assessment is a measure of data collection that encourages participants to give their maximum performance. From the data, the percentage of the results of the validation of the assessment instrument by material experts, media experts and subject lecturers on the assessment instrument is 83.03%, so it shows that the qualification of the assessment instrument that has been developed is very feasible. Revisions are made based on the validator's suggestions and input on the assessment instrument. The revision made is a good and correct SPOK arrangement and order.

The definition of evaluation in general can be defined as a systematic process for determining the value of something (provisions, activities, decisions, performance, processes, people, objects and others) based on certain criteria through assessment. To determine the value of something by comparing it with criteria, the evaluator can directly compare it with general criteria, can also measure something being evaluated and then compare it with certain criteria. In another sense, evaluation, measurement and assessment are hierarchical activities. This means that the three activities in relation to the learning process cannot be separated from one another and in their implementation must be carried out sequentially (Mahirah, 2017).

In addition, according to Abidin (2014), there are several principles of assessment, namely (a) the assessment should be based on comprehensive measurement results, (b) must distinguish between scoring and assessment (grading), (c) in the process of grading It should be noted that there are two kinds of standards, namely non-referenced and criterion-referenced giving, (d) scoring activities should be an integral part of the teaching and learning process, (e) assessments must be comparable. Taroreh et al (2012) states that the quality of the learning system and the quality of the assessment system are interrelated. A good learning system certainly produces a good quality of learning, then the quality of learning will affect the results of student assessment. Therefore, there will be an improvement in the quality of learning by paying attention to these two systems.

CONCLUSION

Based on the results of the research that has been done, it can be concluded that; The research data shows that the percentage of the validation results of project-based biotechnology textbooks by material experts, media experts, and biotechnology subject lecturers is 3.75 so that the textbooks have very decent qualifications. The percentage of instrument / project validation results was 3.32 with the feasible category. This textbook was tested on biology education students at STKIP Persada



Khatulistiwa Sintang at the initial development testing stage. The effectiveness of this textbook is seen from the gain score of 0.54 with moderate criteria, so that it can be declared effective. Based on the results of the scores on the validation questionnaire and trials for STKIP Persada Khatulistiwa Sintang students, it shows valid results while giving a positive response to project-based biotechnology textbook products; development of project-based biotechnology textbooks is suitable for use in the lecture process for students of biology education study programs. The advantage of the book is that the textbook is equipped with a project which involves student activities to work on projects in the form of questions so that they can empower students' cognitive abilities to solve problems, think critically, creatively and understand the material in the book well and can easily apply or relate to everyday life.

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