DEVELOPMENT OF STEM-BASED SCIENCE LEARNING MODULE ON LOCAL WISDOM OF MANGO CULTIVATION IN PROBOLINGGO ON MODERN BIOTECHNOLOGY TOPIC

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Abstract

This study aims to produce an integrated STEM science learning module with local wisdom "Mango cultivation" located in Probolinggo and to find out the students' responses to the subject on the topic of modern biotechnology. This module provided reference for providing science material as well as insight into local wisdom knowledge to empower students and create awareness of maintaining, preserving and developing their environment. The learning process based on local wisdom not just convey culture to students, but rather uses the culture so that students find meaning, creativity, and gain deeper understanding of the material. The modules developed discussed of subject matter, and also link learning materials with local wisdom in terms of STEM. In integrating STEM, students not only directed to understand the material but also given guidance to provide solutions in solving a problem that occurs in local wisdom of mango cultivation in Probolinggo related to modern biotechnology materials in junior high school. This type of research is development research with 4-D research design. This research was conducted at SMP Negeri 2 Probolinggo. The results of this study are the validation of the instructional study that gets score of 3,60 and the validation of the technical review that gets a score of 3,89 so that the validation results of the product developed are valid. Based on the analysis of student responses showed a very positive attitude towards the developed module. It can be concluded that this development module is valid and can be used as teaching material.

Keywords: *Development, Local wisdom, Module, STEM*

1. INTRODUCTION

Sciences (IPA) is one of the subjects in schools which the learning process cannot be separated from the environment. Science material discusses natural phenomena that are arranged systematically and based on the results of research and observations made by scientists. Science learning cannot be separated from the environment, which means that science learning becomes more meaningful if the objects, sources, and teaching materials used are something that exists and is related to the lives and needs of students (Ibrohim, 2015).

Students who still preserve local culture cannot be separated from the efforts of teachers who have acted as learning facilitators. In the future, the challenge for aspiring science teachers is not only the nmch ability to integrate science concepts, but also the ability to design lessons that can make students prevent cultural degradation at adolescence in Indonesia (Parmin, 2015). Facing this reality, one of the smart solutions that can be done to be able to educate students who have superior personalities and uphold cultural values is to integrate local wisdom or regional potential in the student's region with science learning concepts.

The government certainly provides support for efforts to preserve culture by including local culture-based learning programs set out in Government Regulation No. 19 of 2005 on Regulation of National Education Standard Article 14 Section (1), it is stated that the curriculum for Junior High School or other equivalent forms may include education based on local excellence (Damayanti, et.al., 2015). The government regulation is refined in the 2013 curriculum to support learning so that it can take advantage

of culture, namely that the curriculum must be responsive to the development of science, culture, technology and the arts that can build curiosity and the ability of students to utilize it appropriately.

One example is in the Probolinggo region which has local wisdom in mango cultivation. With the local wisdom found in the area, students should be able to study and examine the local wisdom scientifically. Thus, awareness will grow to maintain, preserve and develop the environment through the science learning that has been received. Probolinggo is one of the areas that is the center of mango production in Indonesia (Baliadi, et al., 2015). In addition, at this time the mainstay product of MSMEs (Micro, Small, and Medium Enterprise) in Probolinggo is processed mango, because Probolinggo has a very abundant mango production (Rohmah, et al., 2012).

SMP Negeri 2 Kota Probolinggo in learning already using the 2013 curriculum, where the center in the learning process is the students. However, in learning activities, students still use teaching materials from publishers, so it is not possible to discuss the potential of the region around the school environment. SMP Negeri 2 Probolinggo or in their own city. The results of observations and interviews that have been conducted in SMP Negeri 2 Probolinggo with the local science teachers as source persons, problems related to the implementation of the 2013 curriculum were obtained, including: there was no development of teaching materials carried out by the teachers that were adapted to the characteristics and needs of students, so that it would have an impact on the mastery of science concepts in students. In addition, science learning activities carried out so far still focus on theories that cause students to be separated from the environment. Existing teaching materials or books used by schools at this time still do not utilize learning resources optimally, such as the use of the surrounding environment which has the potential to be integrated into learning (Suwarni, 2015). This situation is of course contrary to Law No 20 of 2003 on Educational System Article 36 section 2 which reads "Curriculum at all levels and types of education is developed with the principle of diversification according to the unit, regional potential, and students". Other problems that are in SMP Negeri 2 Probolinggo is related to the Indonesian Government for the implementation of learning and teaching activities carried out with an online system. SMP Negeri 2 Probolinggo, where for the subject of Sciences (IPA) there is a shortage of modules and teaching materials so that the teaching and learning process becomes less effective.

Meaningful learning using local potential-based science modules can be integrated with the STEM approach. In STEM learning, students have the opportunity to learn Science, Mathematics, and Engineering to solve problems that have realworld applications (Afriana, et al., 2016). In addition, in the 21st century, Science, Technology, Engineering, and Mathematics (STEM) learning has increased internationally. Project Based Learning (PjBL) integrated STEM (Science, Technology, engineering and Mathematics) can increase students' interest in learning, learning is more meaningful which will increase students' mastery of concepts (learning outcomes) (Tseng, et al., 2013). Given the importance of mastering technology and preserving culture, a research was conducted on the Development of STEM-Based Science Learning Modules on Local Wisdom of Mango Cultivation in Probolinggo on the Topic of Modern Biotechnology. With the development of the science module, it is hoped that the developed module will be eligible for use in science learning in junior high schools. The aims of this study were (1) to describe the validity of the STEM-based Science Learning Module on local wisdom of mango cultivation in Probolinggo on the topic of modern biotechnology; and (2) describe student responses.

2. RESEARCH AND METHOD

This type of research is development research. Research and Development produce valid products and determine student responses. The product in question is a STEM-based science learning module on local wisdom of mango cultivation in Probolinggo on the topic of modern biotechnology.

This research was conducted using a 4-D development research procedure developed by Thiagarajan which consists of 4 stages, namely: 1) Define, 2) Design, 3) Develop, 4) Desseminate. At the dissemination stage in this study, it was carried out with a limited spread, specifically only at the school where the research was carried out. The activities carried out at each stage of development are described as follows:

1. Define

   This activity aims to set and define the requirements needed for the learning development. Each product developed requires a different analysis. But in general, at this defining stage, it is carried out by analyzing development needs, requirements regarding the suitability of the product developed with user needs, using the right research and development model for product development. Analytical activities can be carried out means of a literature study or preliminary research.

2. Design

   The Design phase consists of four activities, whicharecriterian-test construction, media selection, form selection, initial design. Activities carried out at the design stage include:

   a. Topic development, specifically identifying learning subjects based on indicators and objectives to be achieved
   b. Module layout design
   c. Design layout and cover
   d. Drafting
   e. Production prototype 1

3. Develop

   At the development stage, the activities carried out were making modified research instruments from Anggraini (2017), Almuharomah (2019), and Anggraini (2020). Next, validate the module on prototype 1 which has been developed by providing a validation sheet to the experts compiled by the researcher, then asked to assess and provide suggestions and comments on the prototype 1 that has been developed.

   Expert validation consists of instructional studies and technical studies. The validation of the instructional study consisted of seven aspects namely aspects of needs, aspects of renewal, aspects of suitability, aspects of effectiveness, aspects of feasibility, aspects of STEM and aspects of local wisdom. Meanwhile, the technical study consists of four aspects, namely the aspects of needs, aspects of renewability, aspects of format and aspects of language.

   On the validation sheet, valid statements are given with intervals of $3 \leq Va \leq 4$, and invalid statements are given with intervals of $1 \leq Va \leq 2$. The results of further calculations are categorized according to the criteria in Table 1.

Table 1. Category Validity

Category Validity	Interval
Invalid	$1 \leq Va \leq 2$
Less valid	$2 \leq Va \leq 3$
Valid	$3 \leq Va \leq 4$
Very valid	$= 4$

(Modified from Hobri 2010)

Description: *Va* is the total average value for all aspects

In addition, at the development stage, the researcher also asked 15 grade IX students in even semester of the 2020/2021 academic year at SMP Negeri 2 Probolinggo to provide responses to the modules developed. Sampling was done by purposive sampling. In practice, students are given modules that are distributed through Google Classroom and asked to study the module as a whole for 3 days and fill out the student response questionnaire given.

4. Desseminate

   The dissemination stage consists of three activities, which are validity testing, diffusion and adoption, and packaging. Products developed to the final stage if the development test shows consistent results and the results of the assessment by experts recommend positive comments.

3. RESULT AND DISCUSSION

The results of research at each stage of development in this study are described as

follows. Activities carried out at the defining stage are interviews and field observations related to teaching materials used in schools, STEM learning, learning local wisdom, and materials that students find difficult. In addition, student analysis activities, task analysis, concept analysis and specification of learning objectives were also carried out.

At the design stage, several activities were carried out, including:

1. Topic development for the material/content in the module

   Based on the results of the studies that have been carried out, the material developed in this module refers to Basic Competencies, namely Basic Competence 3.7 understanding the concept of biotechnology and its role in human life and Basic Competence 4.7 Making one of the conventional biotechnology products (eg tempeh, tape, soy sauce, yogurt, or other products).

   The Basic Competencies are developed into content in modules based on the level of depth and breadth of science material for class IX students. Next, the researcher determines the topic of discussion to examine the STEM aspects of the topic. The topic chosen was the Local Wisdom of Mango Cultivation in Probolinggo. The reason for using mango cultivation as the topic of discussion in the module is because mangoes, mango cultivation, a mango products are very close to the daily lives of students. According to Suastra (2010) learning must try to balance between knowledge and science with the cultivation of scientific values and local wisdom. In addition, through the problems that occur in Probolinggo mango cultivation, students can learn about science, applied technology, engineering, and mathematics.

2. Layout planning, layout design and module cover

   The module layout is arranged in such a way as to make it easier for students to use it independently. Modules are teaching materials that are systematically and attractively arranged which include material content, methods, and evaluations that can be used independently (Tjiptiany, et al., 2016). The STEM-based science learning module consists of the following components:

   a) Cover
   b) Preface
   c) Table of contents and list of figures
   d) Patterns of STEM linkages with modern biotechnology
   e) Concept map on modern biotechnology materials
   f) Terms used in the module
   g) Basic Competencies and Indicators
   h) Introduction
   i) Learning Activities
   j) Answer key
   k) Glossary
   l) Bibliography

Figure 1. Front and back cover of the module

3. Drafting of STEM-Based Science Learning Module Draft on Local Wisdom of Mango Cultivation in Probolinggo on the Topic of Modern Biotechnology

   In this activity, the researcher prepares the material and activities that will be carried out by students into the layout design that has been made previously. This draft module is then referred to as the Prototype I Module.

Figure 2. Draft on the develop module

Activities at the development stage consist of module validation, product revision, STEM concept design developed in the module, and student responses.

1) Module Validation

The module validation was carried out by three people, namely one lecturer of the Natural Sciences Education Study Program, Faculty of Teacher Training and EducationUniversitas Jember for instructional studies and two science teachers from SMP Negeri 2 Probolinggo who had taken master's education and were professionally certified for technical studies. Each validator gets a validation instrument and prototype module I. The validation results will later be used as a basis for making revisions. Validators can provide useful suggestions and input in improving the products developed so that modules that have high validity can be produced. The results of the module validation can be seen in Table 2 and Table 3.

Table 2. Result of Validation of Instructional Studies

No.	Validation aspect	Validation of each aspect	Average validation value (*Va*)	Category
1.	Needs	3	3,60	Valid
2.	Renewal	4		
3.	compatibility	3,67		
4.	Effectiveness	3,5		
5.	Appropriateness	3,6		
6.	STEM	3,75		
7.	Local culture	3,5		

Table 3. Result of Validation of Technical Studies

No.	Validation aspect	Validation of each aspect	Average validation value (*Va*)	Category
1.	Needs	3,75	3,89	Valid
2.	Renewal	4		
3.	Format	3,81		
4.	Language	4		

2) Product Revision

Qualitative data in this study are in the form of general assessments, suggestions, and comments as supporting data to revise the module, which has been tested for validity by experts/logic consisting of instructional studies and technical studies, the next step is to revise the product. based on the suggestions and inputs obtained from the validators.

Some suggestions and comments put forward by validators in instructional studies are the need to add more illustrations related to material explanations and local wisdom of Probolinggo mango cultivation and to make sure that every page has pictures that support the explanation. The module must provide an overview of the basic competencies that students want to achieve, made using good and interesting language, also equipped with clear and not confusing illustrations (Widyastuti, et al., 2021). According to Rusdiana (2013), the existence of varied and colorful graphics or images will make an interesting impression. The use of graphics or images must be in accordance with the material informed in the module so as to make it easier for students to understand the material.

Suggestions and comments submitted by validators in technical studies are improvements or revisions to the format aspect, namely the need to add more illustrations of local wisdom of mango cultivation in Probolinggo in learning activities 3 so that students know more about their culture. Another improvement in the format aspect is changing the use of light microscope images in the cover design with electron microscopy to suit the technology used in modern biotechnology. Another suggestion given by the validator is the need to add practice questions to learning activity 2 and it is necessary to improve on the practice questions that have not found the answer key and the measurement of the level of mastery of students after studying the module. According to Saputra (2020) one of the functions of the module in the learning process is as an evaluation tool, which means that with the student module, students are required to be able to measure and assess their own abilities and level of mastery of the material that has been studied. Thus, the module is also an evaluation tool.

3) Student Response

Student response activities are carried out online. The researcher gave a questionnaire in the form of a google form link that was distributed through Google Classroom. The trial was carried out by conducting familiarization of the developed module to students. Researchers conducted a

brief review to students regarding modern biotechnology materials. After reading the module as a whole, students are given a questionnaire to assess the module. Student response questionnaire data were analyzed based on the assessment of the questionnaire given to students. The student response data can be seen in Table 4.

Table 4. Student response data to the develop module

No.	Indicator	Average percentage of agreement	Category
1.	Like	97,8%	Very Positive
2.	New	93,3%	Very Positive
3.	Easy	73,3%	Positive
4.	Understand	93,3%	Very Positive
5.	Interesting	100%	Very Positive
Average		**91,54%**	**Very Positive**

Based on table 4, it is known that the average percentage of agreement on all indicators of 91.54% is included in the very positive category (Arikunto 2010). These results indicate that the overall module that has been developed has received a very positive response from students. There were also some responses given by students to the prototype 2 module, including suitable for use as a learning resource to prepare for the National Science Competition (NSC) in the science field, the material is quite complete and easy to understand, the terms in the complete module are added with the definition of each term in the glossary that makes learning easier, students like activities in modules that use slapping ropes to make it easier to understand the shape of DNA, first time experience for students learning to use modules that integrate local wisdom so as to increase their knowledge of mangoes in Probolinggo , and gain insight and motivation to learn during online learning. It is hoped that with the characteristics of modules as teaching materials that are studied independently by students, students have an attractive appearance and use simple language (Pratiwi 2015) and a module can have meaning if students can easily use it. (Pratiwi, et al. 2017).

4. CONCLUSION

Based on the explanation of the results and discussion, it can be concluded that the STEM-based science learning module on local wisdom of mango cultivation in Probolinggo on the topic of modern biotechnology has valid criteria and received a very positive response from students. Thus, it can be stated that the STEM-based science learning module on local wisdom of mango cultivation in Probolinggo on the topic of modern biotechnology can be used as teaching material in schools.

The suggestions that can be put forward in the development of STEM-based science learning modules on local wisdom of mango cultivation in Probolinggo on the topic of modern biotechnology are as follows, research trials should be carried out on a wider scale, this module needs to be tested in direct learning activities to test the effectiveness of the module. , and this research can be continued for the development of STEMbased science learning modules on various student abilities such as 4C abilities (scientific literacy, scientific reasoning and others).

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