Development of Ecology Material Biology Modules Based Problem Solving

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Abstract

The improvement of the learning process is carried out by innovating, one of which is the development of learning media in the field of Biology. The developed media is in the form of modules that are integrated with problem solving models on ecological materials. The purpose of this research is the Development of Problem Solving-Based Biology Learning Module on Ecological Materials. This research model is a research and development (Research & Development) which aims to develop a problem-solving biology-based learning module on ecological materials. Research and development R&D is the process used to develop and validate products. This research procedure uses the development model developed by Thiagarajan namely define, design, development and dissemination.

Keywords: 4D, ecology, modules, learning biology, problem solving

INTRODUCTION

Education is a place to prepare and improve the quality of human resources through formal and non-formal institutions (Sari et al., 2021). The concept of education can develop the potential of learners. Along with educational goals that build student development, high schools (SMA) have an essential role and responsibility in continuing good and suitable education. The process of change in the world of education is by innovating in the learning process (Dewi et al., 2014).

One of the educational problems is the low quality of education; the lack of teacher interaction with students can cause different levels of students' understanding. The 21st century has unique characteristics in improving students' abilities in academic units, both hard and soft skills. Therefore, the learning process must follow 21st-century studies. Some of the abilities that must be possessed are critical thinking and problem-solving, communication, collaboration, and creativity. Problem-solving is essential, so students must think and solve problems in learning (Hiko et al., 2022; Mangesa, Lamada et al., 2021; Neno et al., 2022; Novita et al., 2022; Nurjannah & Susiyawati, 2021).

Problem-solving activities need to collaborate with learning media in learning tools. Learning activities can run effectively if innovative learning media are available so that adequate knowledge, good skills, attitudes, and learning experiences can be achieved through modules and textbooks. (Ade et al., 2021; Bare & Sari, 2021; Selmin et al., 2022; Ule et al., 2021).

Modules are defined as independent learning packages that include learning experiences that have been systematically planned and designed for students to achieve learning goals and energy to achieve goals optimally (Pratiwi, 2013; S & Bare, 2019; Sizi et al., 2021).

The development of problem-solving-based learning modules aims to develop exciting teaching materials, complete as independent learning materials, and provide opportunities for students to find out and solve problems independently. (Wartini et al., 2018).

Observations and interviews with teachers and students at SMAN 1 Talibura revealed that in learning activities, only some teachers use modules as one of the student learning materials. Learning is still centered on the teacher, and students record essential things. During the pandemic, biology lessons at SMAN 1 Talibura took place online. Teachers give more assignments than students are asked to work on and collect them online. One of the materials in biology learning that is widely considered is ecological material. Understanding of ecological material is still rote, where students are forced to memorize several concepts so that mutual interaction does not occur, and there is still a lack of problem analysis.

Factors causing the need for more success in learning biology, especially ecological material, namely the motivation and interest of students. Less active students and lack of motivation and interest of students in biology subjects. From the results of these observations and interviews, the researcher is interested in conducting research and producing a module that aims to increase students' learning activity and skills. This research aims to develop a Biology Module for Ecological Materials Based on Problem-Solving.

RESEARCH METHODS

Time and Place of Research
This biology module development research took place at SMAN 1 Talibura, Jl. Maumere – Larantuka, Village. Nanghale, Kec. Talibura, Kab. Sikka, East Nusa Tenggara Province. Research Implementation 22 November-17 December 2021.

Research and Development Model
This research model is research development (Research & Development). Research and development R&D is a process used to develop and validate products. The research procedure uses the development model developed by Thiagarajan (1974), namely definition, design, development, and deployment. This research and development method primarily aims to produce specific products(Hanafi, 2017)

Data analysis
The Problem Solving-Based Biology Module
was validated by linguists, material experts, and media experts. The steps of validity analysis can explain data analysis techniques, student and teacher responses, scoring by validation using a Likert scale with a scale of 5, then entered into the column of the Product Validity scale adapted to ResearchAde et al. (2021) and; Elci et al., (2021). Widoyoko (2014)explains that the general formula for calculating scores and product categories in the Module (Table The product feasibility test is completed by filling out a questionnaire for students and teachers.

Table 1. Scores Range Into Product Categories

No	Score Range	Category
1	X>(Mi+1.8SBi)	Very worth it
2	(Mi + 0.6 SBi) <X ≤ (Mi + 1.8 SBi)	Worthy
3	(Mi - 0.6 SBi) < X ≤ (Mi + 0.6 SBi)	Enough
4	(Mi - 1.8 SBi) <X ≤ (Mi - 0.6 SBi)	Not enough
5	X ≤ (Mi – 1.8 SBi)	Very less

The results of the Module feasibility assessment questionnaire from the teacher were then processed into Module feasibility assessment categories (Table 1).

Table 2. Product Categories of Module Feasibility Assessment Results by the Teacher

No	Score Range	Category
1	X > 81.6	Very Worth it
2	67.2 < X ≤ 81.6	Worthy
3	52.8 < X ≤ 67.2	Enough
4	38.4 < X ≤ 52.8	Not enough
5	X ≤ 38.4	Very less

The category of product assessment for module eligibility by teachers (Table 2) and eligibility for students (Table 3) are adjusted to the number of statement items.

Table 3. Module Feasibility Assessment Product Category by Learners

No	Score Range	Category
1	X > 83.94	Very worth it
2	67.98 < X ≤ 83.94	Worthy
3	52.02 < X ≤ 67.98	Enough
4	36.06 < X ≤ 52.02	Not enough
5	X ≤ 36.06	Very less

RESULTS AND DISCUSSION

Development of problem-solving-based ecological material modules on ecological material at SMA Negeri I Talibura. The biology module was declared very valid based on the validation results from the material, language, and media validator. In the small and large class trials, the biology module was very feasible to use. The stages carried out in research, and development are as follows:

1. **Define the Biology Module in Ecological Materials**
   The definition stage includes:
   a. Problem Analysis
   b. The learning process at SMA Negeri I Talibura is still teacher-centered due to limited learning materials, so students tend to be passive in learning. Students use textbooks prepared by the school during learning. Therefore, the development of learning modules for ecological material is carried out.
   c. Student Analysis
   In interviews with biology teachers at SMA Negeri 1 Talibura, students' understanding of ecological material varied, and some students they were still considered ecological material difficult because it contained memorization.
   d. Task Analysis
   Task analysis of competency standards and essential competencies related to the ecological material developed in the biology module..
   e. Learning objectives
   Formulate learning objectives from ecological material, namely defining the notion of ecology as a science and analyzing ecosystem components and the interactions that occur in them..
2. **The Design Stage in the Ecology Module**
   The design stage of the biology module for ecological material at SMA Negeri I Talibura.
   a. Device arrangement

Learning tools are arranged in the form of a syllabus and learning implementation plan (RPP) which will be used as a guide for the preparation of modules.

b. Initial product design

The module developed was made by researchers using the Microsoft Word application. The steps taken at this stage are:

1) **Cover Page**

*cover*a module consisting of a module title namely Ecology, pictures of interactions between living things and plants, as well as the identity of the research college.
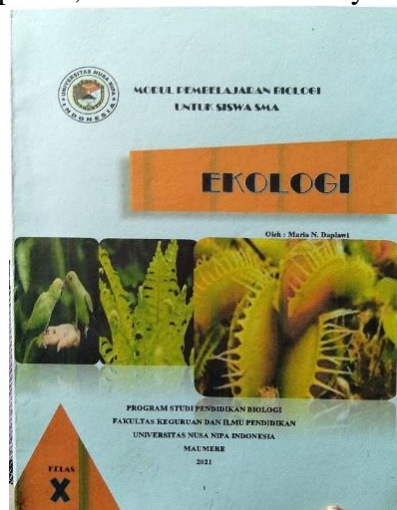
Figure 1. Cover View

The cover color is designed in blue (Figure 1).

2) **Foreword**

The preface contains thanksgiving to God Almighty and the purpose of module development which refers to the 2013 curriculum where students are invited to solve and find problems.

3) **List of contents**

The table of contents provides information about the material covered in the module, as well as page numbers to make searching easier.

Figure 2. Table of contents view

The background used is white. In the table of contents display, there are also illustrations of reading books, this makes the table of contents look more attractive (Figure 2).

4) KI, KD and GPA

Core Competencies based on the 2013 curriculum. There are two core competencies (KI3 and KI 4) (Figure 3).

Figure 3. Display of KI, KD and GPA

Basic competence aims to achieve competency standards students must obtain through learning (Figure 3). The Competency Achievement Indicators are derived from KD, which students in learning activities must achieve.

5) Concept maps
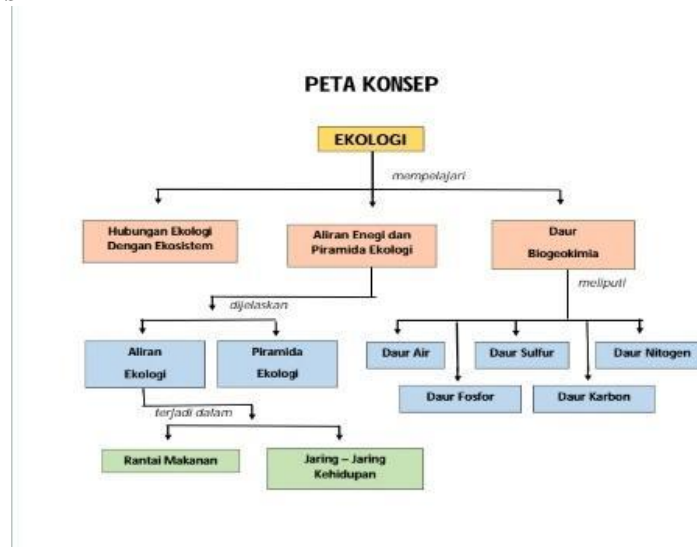
Figure 4. Concept map view

This is an overview of the contents of the ecological material used in the module. This is to facilitate understanding of a material. The background used is white (Figure 4.).

6) Glossary

Figure 5. Glossary view

The glossary is arranged alphabetically (Figure 5).

7) Bibliography

The bibliography contains references to biology learning modules on ecology material.

3. Development Stage (Develop)

The development stage includes the process of making modules, the first stage of validation and revision and input from validators and small-scale and large-scale tests.

a. Expert validation

Learning modules are validated by material, media and language validators. The module has been developed, then the next stage is module product validation.

Table 4. Validation Result Data By Validator

No	Validators	Validation Results	Average	Validity Level
1	Medium 1	84,2	90.5	Very Valid
2	Medium 2	96.8		
3	Material 1	98.6	97.9	Very Valid
4	Material 2	97.3		
5	Language 1	96	85	Very Valid
6	Language 2	74		

1) Material Validators

The number of statements assessed by the material validator was 15 statements. There are several suggestions from the material validator, namely that it is better to include KI and GPA on the front with KD, then make it on one page. The conclusion from material validation is that it is very valid (Table 5).

Table 5. Revisions and revision results based on material experts

Before revision	After revision

2) Media Validators

The validation carried out by the media validator gets suggestions and improvements. Namely, the glossary should be placed at the end before the bibliography. The conclusion from media validation is that it is very valid to use (Table 6).
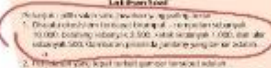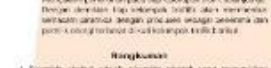
Table 6. Revisions and revision results based on media experts

Before revision	After revision
The glossary is at the front before the concept map.	The glossary is behind before the bibliography.

3) Language Validators

The advice given by the language validator is to improve practice question number 1 in the ecological pyramid material where there is no observable choice, then question number 2 does not have a picture, fix question number 9 about the evaluation using question C4 (Table 7).

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Table 7. Revisions and results of revisions by linguists

Before revision	After revision

The ratings given by the validators are classified as "Very Valid" criteria (Table 4). This study follows research from Sari et al. (2021), which states that a valid category can be continued in the practicality test process. The second is research conducted byIsnani, and Nuraida (2020) criteria biology module is very valid. Bare et al. (2021) learning media in the form of a display has a high student response.

b. Module Eligibility

Researchers and teachers learn according to the learning model used in the product being developed. During learning activities, researchers and teachers use modules.

Table 8. Data Analysis of Small Class Trial Results

No	subject	Average	Criteria
1	Teacher	97.2	Very Worth it
2	10 Students	94.85	Very Worth it

1. Small class trials

The module product feasibility questionnaire aims to obtain suggestions and opinions regarding activities in the biology learning module as a refinement of module products on ecology material. The advice from small-scale trials is to add more background colors and animations to make them more attractive. In small class trial results with a total of 10 students, the average score for students was 94.85 and categorized as very feasible. In contrast, the average assessment score for educators was 97.2, categorized as very feasible (Table 8). Research andThis development is supported by the results of research conducted by several researchers, including research thatNuriadila et al. (2019) regarding the development of a problem-solving-based biology module on excretory

system material in class XI IPA, where student responses to the module during the trial gave a positive response of 88.96%. The second is the result of research conducted byAflaha et al. (2015) about the Development of Problem-Solving Based Modules in the Electronics Course. Student responses in the small trial obtained 84% in the outstanding category. The Problem-Solving Learning Model has also been integrated with learning media and produces very feasible products (Archambault et al., 2008; Elci et al., 2021; Mason & Singh, 2010).

2. **Large class trials**
The biology module on the revised ecological material was then tried out in a large class trial. Suggestions from large-class trials are used as input for product improvement in the biology module on ecological material, which is used for the final refinement of the biology learning module on ecology material.

The assessment for students was 98 and categorized as very appropriate, while the average score for biology educators was 98.5 which was categorized as very feasible (Table 9).

Table 9. Results of Analysis of Large Class Trials

No	subject	Average	Criteria
1	Teacher	98.5	Very Worth it
2	20 Students	98	Very Worth it

Study Wahyuningtyas et al. (2019), during the large group trial, there was an increase of 72.58% with a high qualification. Aflaha et al. (2015) explained that the Problem-Solving Based Module obtained excellent student responses. Besides thatPermana et al. (2021) electronic modules in the science subject of the digestive system that meet the requirements and are suitable for use as teaching materials for class VIII students. The developed media will provide functional value to the learning outcomes and students' understanding of the learning process (Dawa et al., 2021; Ndia et al., 2021; Pada et al., 2021; Ra'o et al., 2021).

3. **Deployment of Biology Learning Modules in Ecological Materials**
The limited dissemination stage at SMA Negeri 1 Talibura, by providing biology module products to 2 biology educators and two students at SMA Negeri I Talibura. The resulting module has the following advantages:
a. The material presented in the module can motivate students and add insight because the material is arranged systematically.
b. The presentation of the contents of the module is accompanied by KI, KD, GPA, concept maps, instructions for using the module, learning activities, a glossary, and a bibliography.

CONCLUSION

Based on the results of research on the Development of Biology Modules for Ecological Materials Based on Problem-Solving, SMA Negeri I Talibura was declared valid and included in the very feasible category to be used in teaching biology on ecological materials.

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