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Project-Based Learning (PjBl) Green Pedagogy E-Module in Improving Creative Thinking and Digital Literacy

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A B S T R A C T

The PjBL learning model needs to be outlined in a learning module to help learning be more interesting and effective. During the two years of the implementation of the green pedagogy course, there has been no PjBL-based learning module that can be used by students. This research aims to produce PjBL-based e-modules to improve the effectiveness of green pedagogy learning. This research is a Research and Development (R&D) research using the ADDIE model, with development steps namely; Analysis, Design, Development, Implementation, and Evaluation. The research sample is 30 students who are taking green pedagogy courses. The research instrument consisted of a validation sheet with descriptive data analysis techniques. The module feasibility testing stage is carried out by product validation by two experts. Based on the results of the study, it was concluded that PjBL-based e-modules are very valid and can be used in the learning process.

1. Introduction

Biology education is not only about transferring knowledge about living organisms, but also about developing environmental awareness and responsibility. Green pedagogy, which focuses on the principle of sustainability, plays an important role in shaping students' thinking regarding how biological sciences can be applied to solutions to environmental problems (Firdaus, 2017). In this case, critical and creative thinking of students is needed in providing innovative solutions, but based on the results of learning observations so far, students have low critical and creative thinking skills because they have not been able to solve problems.

Traditional teaching methods that have been applied tend to be less stimulating and motivating for students. In biology education, where the relationship between real life and theoretical concepts can be very relevant, a more contextual approach is needed. Project-Based Learning (PjBL) is a learning model that uses contextual problems and finds solutions through critical and creative thinking (Azzahra, 2023).

The PjBL learning model needs to be outlined in a learning module to help learning be more interesting and effective. During the two years of the implementation of the green pedagogy course, there has been no PjBL-based learning module that can be used by students. So that PjBL-based learning has not been optimal and has not produced concrete solutions to global problems that are so complex today.

In response to this, it is important for educational institutions to integrate sustainability concepts in their curriculum. The integration of PjBL in learning will be a supporter of the implementation of the Key Performance Index (KPI), namely IKU 7, which is the foundation for the transformation of Higher Education. The development of a PjBL-based green pedagogy learning module is a concrete step in supporting continuing education and creating prospective biology teachers who are able to instill sustainability values in their students.

The modules developed are expected not only to enrich the learning experience of prospective biology teacher students but also to improve their skills. Flipbook-based E-Modules are interactive learning resources that can improve students' literacy skills (Aprilia, 2017). The results of the study show that currently students' digital literacy skills are still relatively low, because they are only able to find information, but cannot manage it appropriately into new knowledge (Kurnia, 2021).

The development of an integrated flipbook-based E-Module PjBL is certainly a solution in improving students' creative thinking skills and literacy in the Green Pedagogy course. In this way, this research can make a positive contribution to improving the quality of biology education at the higher education level. This research will consider the views and needs of prospective biology teacher students through surveys and interviews, ensuring that the modules developed are relevant to the challenges and demands of the current world of education.

2. Methodology

a. Location and Time of Research

The research will be carried out at the University of Riau, Pekanbaru City, with a research time of 7 months.

b. Type of Research

The type of research conducted is research and development (R&D). According to Plomp (2013), this study designs and develops interventions (such as learning programs, learning strategies and teaching materials, products and systems) as solutions to complex educational problems. This model consists of the initial investigation phase, design, realization, validation, trial and revision, and implementation (Arianatasari, 2018).

c. ADDIE Development Model

The development model used in this development is the ADDIE Model which is one of the systematic learning design models. This model is arranged programmatically with a systematic sequence of activities in an effort to solve learning problems related to learning resources that are in accordance with the needs and characteristics of learners. This model consists of five steps, namely: (1) analyze, (2) design, (3) development, (4) implementation, and (5) evaluation. Visually, the stages of the ADDIE Model can be seen in Figure 1.

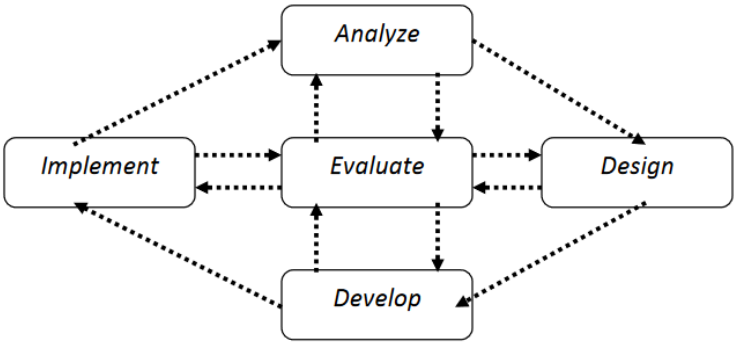


Figure 1. Design of ADDIE Development Model

d. Data Collection Instruments

In this study, the stages that produce research data are the analysis, development, and implementation stages. The data obtained from this study are described through Table 1.

Table 1. Stages of Research Activities

No	Activities	Data Collection Instruments
1	Analysis of student needs	Questionnaire
2	Validation	Questionnaire

e. Data Analysis Techniques

Data analysis of student needs and validation is carried out descriptively in the form of graphs. The observation data was also analyzed descriptively. Meanwhile, the data obtained from cognitive tests were analyzed by inferential analysis using the SPSS application.

Product validation was carried out by 2 validators consisting of media expert lecturers and material expert lecturers. The validation instrument uses a likert scale consisting of 1-4. The validation results are calculated using the average score formula, namely:

$$\mathbf{M = (\sum fx)/N}$$

Information:
M = Average score
Fx = Score earned
N = Number of validation components

Furthermore, the validation results that have been provided by the validator are categorized according to the following Table 2.

Table 2. Validity Category

Score Interval	Validity Category
$3.25 \leq x < 4$	Highly Valid
$2.5 \leq x < 3.24$	Valid
$1.75 \leq x < 2.4$	Less Valid
$1 \leq x < 1.74$	Invalid

Sugiyono Modification (2020)

3. Results and Discussions

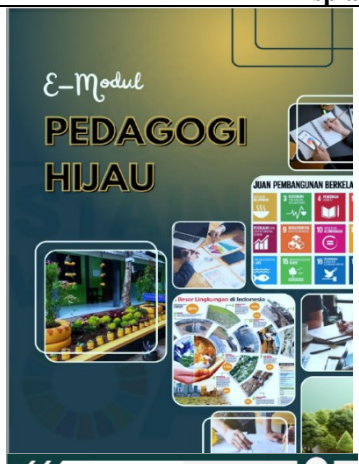
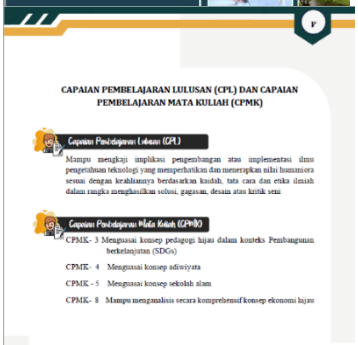
The initial stage of e-module development is the analysis stage. The analysis stage was carried out by observing and interviewing several lecturers in the green pedagogy course. The results of the interview showed that the use of project-based *learning* (PjBl) modules has not been applied in learning. In addition, the results of observation and analysis of lecture teaching materials also found that the procurement of lecture modules that can improve students' creative thinking and literacy skills is still limited, *the project-based learning* method has not been used thoroughly in learning so that the development of project-based *learning modules* is very important.

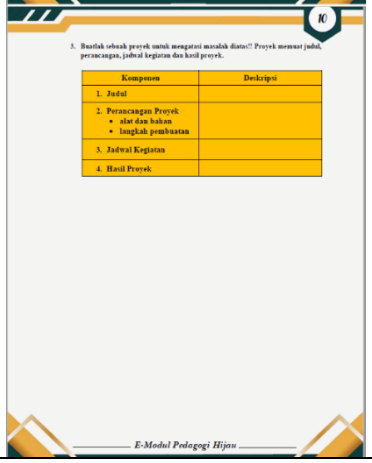
Curriculum analysis is carried out by reviewing the Semester Learning Plan (RPS) of green pedagogy courses which includes analysis of graduate learning outcomes, course achievements and also learning materials. The results of the analysis show that green pedagogy materials that can be integrated with the PjBl learning method are on the topics of SDGs, Adiwiyata, nature schools, and green economy. The four topics were then developed into an e-module that began with a case, then the steps to solve the case produced a product in accordance with the PjBl method.

Development of Green Pedagogy E-Module

The development of green pedagogy e-modules begins with material analysis, case search, and preparation of the steps of the PjBl method.

Table 3. Green Pedagogy e-Module Design

Fill	Display
Cover	
Presentation of CPMK	
Fill	

Case Presentation	
PjBl Activities	

The design stage contains the stages of designing the design of the PjBl-based e-module. These three aspects are then used as a reference for the development of e-modules. Furthermore, at the development stage, the e-module is developed according to the development reference.

Validity of Green Pedagogy E-Module

The E-Module developed is validated by experts or validators, namely media experts and material experts. Case method-based module validation is carried out to assess the validity, practicality, and effectiveness of the module products developed. Some suggestions for improvement from experts such as the use of images, ineffective sentence writing, the use of too small spaces and improvements to the bibliography. Validation from media experts is presented in Table 4 below.

Table 4. Results of Validation by Media Experts

Aspects	Average	Category
Linguistics	3,75	Highly Valid
Serving	3,5	Highly Valid
The Effect of Media on Learning Strategies	3,5	Highly Valid
Thorough Design Feasibility	4	Highly Valid

The validation results from the material experts include the learning aspect and the content aspect, which are presented in the following Table 5.

Table 5. Results of Validation of Learning Aspects and Module Content

Aspects	Average	Category
Learning	4	Highly Valid
Fill	3,83	Highly Valid

The results of the validity of the green pedagogy e-module from two validators showed that the category was very valid. This indicates that the e-module is very feasible to be used in learning green pedagogy by students.

Implementation of Green Pedagogy E-Module

After validation by validators, implementation was carried out for 30 students who took green pedagogy courses. It is known that all six indicators got results that were categorized as very good (Table 6)
Learning using the Green Pedagogy E-Module is known to support digital literacy skills and student creativity skills, this is seen from the results of its high percentage, which is above 88%.

Table 6. Results of Student Response Questionnaire

No	Indicators	Percentage (%)	Response Criteria
1	Materials help achieve sub CPMK 1	88,25	Excellent
2	Sequence and systematic material 2	92	Excellent
3	E-modules support digital literacy skills	94	Excellent
4	E-modules support creativity	88,25	Excellent
5	Linguistics	90	Excellent
6	E-Module Design	90,25	Excellent
7	PjBL Syntax	92,75	Excellent

The E-Module integrated with the Project Based Learning (PjBL) model gave an excellent response from students of 92.75%. The provision of the PjBL model has a positive impact on learning, especially on student involvement in a project to develop critical, creative, and collaborative thinking skills (Alhayat *et al*., 2023). The PjBL model is able to provide great opportunities for students to explore their creativity. The percentage of PjBL-based green pedagogy E-Module received a niai of 88.25% with a very good category. This is in accordance with Wahyuni's (2021) research, PjBL-based *E-books* can improve creative thinking skills and are declared valid with a percentage of 94.08%. Likewise, according to the research of Rahmi *et al*., (2023), *a flipbook-based e-module with a PjBL learning model is effective and able to improve students' creative thinking skills with a nii of 87.5%.*

Digital literacy is a person's ability to use various kinds of media to access, analyze, and produce information for the needs of a person's daily life which will be influenced by the media around them in the form of the internet (Shavab, 2020). Electronic-based modules or e-modules are able to support students' digital literacy skills. The results of the percentage of student responses to the ability of e-modules in supporting digital literacy skills were 94% with very good response criteria. This is in line with the research of Yuliastini *et al*., (2022), which stated that the use of e-modules provides an increase in digital literacy skills for students with an increase from 37% to 70%.

Acknowledgments

Based on the results of the study, it can be concluded that the project-based green pedagogy e-module on green pedagogy material is valid and can be used to improve students' creative thinking skills. Further research is expected to develop project-based learning-based e-modules on other materials.

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