



Bio-entrepreneurship Module: Building Ecoliteracy Skills for Prospective Biology Teachers Through Creative Problem-Solving Learning

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Abstract

Background: Fierce competition requires graduate students from IKIP PGRI Pontianak to have pedagogical abilities, soft skills, hard skills, and interpersonal skills that can be used in the world of work. The research will aim to develop Bio-entrepreneurship teaching materials based on Creative Problem Solving to train eco-literation skills. **Methods:** The research method uses research and development intending to produce a new product that refers to the ADDIE development model, which includes five stages, namely, Analysis, Design, Development, Implementation, and Evaluation. The research was carried out in the Biology Education Study Program; before the product was given to experts, researchers tested Bio-entrepreneurship teaching materials based on Creative Problem Solving to train eco-literation skills. **Results:** The next validation stage will involve material and media experts, and research will involve students taking the Bio-entrepreneurship course in the Biology Education Study Program, which was previously given a pre-test and post-test. The research instruments used are expert validation sheets, product assessments, questionnaires, and eco-literation tests. Data analysis was carried out on the results of expert validation, student responses, and student learning outcomes using SPSS. Bio-entrepreneurship Teaching Materials Based on Creative Problem Solving meet the criteria of validity and practicality based on the results of assessments from media experts and material experts, based on the calculation of N-gains, a value of 61,267 or 61.27% is included in the category of quite effective. **Conclusions:** Bio-entrepreneurship Teaching Materials Based on Creative Problem-Solving meet correct categorizations and are adequate for learning.

Keywords: Bio-entrepreneurship; Creative Problem Solving; Eco-literation



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Introduction

IKIP PGRI Pontianak is a higher education institution in science that focuses on developing Community Resources in the field of education and has lecturers committed to continuing to establish themselves and carry out activities of the Tridharma of Higher Education. Demands are also increasing, so IKIP PGRI Pontianak lecturers are required to create quality graduates according to the higher education target IKU achievement formulated in the strategic plan of the Ministry of Education and Culture and line with the IKIP PGRI Pontianak Strategic Plan.

Fierce competition demands that graduates from IKIP PGRI Pontianak have provisions of both pedagogical abilities, hard skills, and soft skills that can be used in the world of work in both educational and non-educational fields. Hard and soft skills are

needed, and managing one's emotions and emotions when building relationships with others is known as interpersonal skills (Cahyadiana, 2020). Meanwhile, (Aqil et al., 2019) state that improving life skills will be able to encourage students to be more creative in managing information about products or services, such as knowledge about the application of biological effects from the results of scientific research into products that can be marketed and have high economic value through Bio-entrepreneurship.

Students of the Biology Education Study Program are equipped with academic skills to teach in the classroom and various knowledge about living things, both animals and plants. So that the Biology Education Study Program can produce productive graduates who have integrity, are creative, and reason critically about changes that occur in the surrounding environment.

The importance of conveying knowledge to prospective teacher students for teaching provisions later in school was given by (Aqil et al., 2019). Based on the results of the research conducted, there is an increase in interest in entrepreneurship and student life skills before and after the application of Bio-entrepreneurship learning. Meanwhile, according to (Prihatiningrum et al., 2020), Bio-entrepreneurship positively increases biology learning achievement, creativity, and interest in entrepreneurship. Not only through bio entrepreneurship-based learning activities but various bio-entrepreneurship teaching materials are still needed according to the Biology material that will be taught by teachers to students (Budiono, 2014). Similar results were conveyed (Kristanti et al., 2012) that bio entrepreneurship-based teaching materials are effective in classroom learning and can increase students' entrepreneurial attitude and interest through activities to make nata de soya and soy-yogurt.

Students in schools still often consume drinks and food packaged using plastic. The use of plastic contributes to an increase in plastic waste that is difficult to decompose naturally and endangers the survival of marine life when garbage is carried into the ocean through streams. Students in schools prefer plastic packaging that poses a risk to health and the environment rather than bowls, plates, and glasses that are safer for food (Rahmawati et al., 2019). Therefore, efforts are needed to instill knowledge about theoretical and practical waste processing and the use of plastic waste through the 3R (Reduce, Reuse, and Recycle) concept.

Students of prospective biology teachers are expected to have eco-literation skills so that later when teaching, they can integrate them into learning biology subjects in schools. Future teacher students can integrate eco-literation skills through Creative Problem Solving learning. For this reason, lecturers should be able to develop printed and electronic teaching materials that are creative, innovative, and have the latest by the changing conditions of the times that students can use to master eco-literation skills in processing plastic waste by integrating them into Bio-entrepreneurship lectures.

Using appropriate teaching materials by lecturers will facilitate the implementation of learning Bio-entrepreneurship material. At the same time, for students, it will be beneficial and make it easier for students to understand what is being taught by the lecturer. Lecturers must be able to adapt and integrate their knowledge by adding learning activities that stimulate the mastery of pedagogical skills, hard skills, soft skills, and student eco-literation skills. This opinion aligns with (Nugraheni & Winarni, 2019), who states that developing science entrepreneurship teaching materials can develop students' mindset to be more open to innovating science learning. This research is in line with the vision and mission of IKIP PGRI Pontianak, where one of the visions is to create superior graduates, namely graduates who excel in mastering learning support technology, mastering 4C abilities (Communication Ability, Collaboration, Creativity, and Critical Thinking) and life skills (Career Skills).

The novelty of the research that will be carried out is that researchers strive to create teaching material for the Bio-entrepreneurship course by integrating Creative Problem Solving to train eco-literation skills in processing plastic waste into useful materials and have high economic value, such as; study desks, cutting boards, tissue holders, and table

tennis rackets, and other eco-friendly products. The teaching materials developed can later be used by students of prospective Biology teachers in teaching-learning materials for environmental damage and pollution in schools. So based on this background, this study aims to determine the validity and effectiveness of developing Bio-entrepreneurship teaching materials based on Creative Problem Solving to train eco-literation skills for prospective biology teacher students at IKIP PGRI Pontianak.

Method

This type of research is development research (research and development) to produce a new product in the form of Bio-entrepreneurship Teaching Materials that students in Bio-entrepreneurship lectures can use. The development procedure is the researcher's systematic steps when creating teaching materials. The development procedure in this study uses the ADDIE (Analyze, Design, Development, Implementation, Evaluation) model. The selection of the ADDIE model is very suitable for the type of research and development that produces products in the form of modules. The ADDIE stages of the model can be seen in Figure 1.

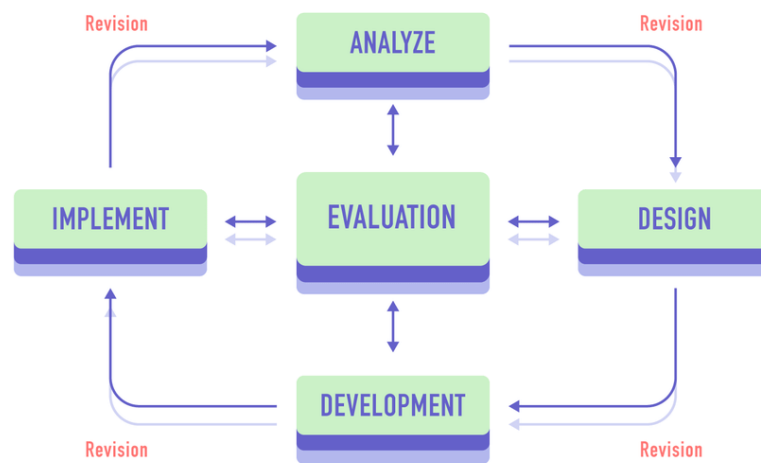


Figure 1. ADDIE Model Stages (Tegeh et al., 2020)

Subject or Participant

The research subjects in this Development Research are; 1) one Material Expert and one Media Expert as a validator. The experts referred to in this study are experts or experts who will validate products, known as validators. Material experts in this study are experts or experts who will assess the suitability of the material contained in the teaching materials by integrating Creative Problem Solving in training the eco-literation of plastic waste management into eco-friendly products, where biology material experts are lecturers in Biology Education. The media experts in this study are experts or experts in the educational media who are lecturers of IKIP PGRI Pontianak. 2) The subject of Product Trials in this study is a student of the Biology Education Study Program IKIP PGRI Pontianak. The selection of research subjects was conducted using the Purposive Sampling Technique, where the module user subjects were students of the biology education study program who took bio-entrepreneurship courses.

Data collection and Data analysis

The validity assessment is carried out using material validation questionnaires and media validation. Furthermore, the quantitative and qualitative data revision stage is carried out, equipped with input and suggestions from media and material experts. Quantitative data is obtained using a Likert scale consisting of five criteria that will be analyzed with the following rating result formula:

$$HR = \frac{\sum \text{validator answers}}{\sum \text{The validator 's the highest score.}} \times 100\%$$

Table 1. Product Validity Level

Evaluation	Value Scale	Percentage Rating Results (%)
Highly Valid	5	86-100
Valid	4	66-85
Quite Valid	3	51-65
Invalid	2	36-50
Highly Invalid	1	20-35

Source: Riduwan in (Rahmawati et al., 2020)

Effectiveness testing is carried out through limited field trials carried out using pre-test and post-test to determine the differences in eco-literation skills of experimental group students before and after using teaching materials that have been developed, data analysis techniques using N-gains tests.

Table 2. Categories Earning N-Gain Score

N-Gain	Category
$g \geq 0,7$	High
$0,3 \leq g < 0,7$	Moderate
$g < 0,3$	Low

Source: (Hidayati et al., 2019)

Table 3. Modified Gain Interpretation of N-Gain Score Effectiveness

N-Gain Percentage (%)	Category
< 40	Ineffective
40-55	Less Effective
55-75	Moderate Effective
>76	Effective

Source: (Saekawati & Nasrudin, 2021)

Result and Discussion

Based on the sequence of steps or stages of research and development of the ADDIE Model, the research steps to be carried out can be described as follows; The first stage in the development that has been carried out is; 1) researchers analyze and identify problems faced in the learning process of the Bio-entrepreneurship course in the Biology Education Study Program. The results were used to compile material for developing Eco-literation-based teaching materials. 2) analyze the characteristics of students who use Bio-entrepreneurship teaching materials based on Creative Problem Solving to train eco-literation skills in using or processing plastic waste. Researchers conducted a descriptive analysis by collecting information from fellow teaching lecturers in the Biology Education Study Program. 3) Analyzing the concept of Bio-entrepreneurship teaching materials based on Creative Problem Solving, used by making learning tools. 4) Analyze the assignments to be given so that students can train and have eco-literation skills in processing plastic waste.

The second stage in this study is design, where researchers design titles, product covers, learning objectives, materials, and evaluations. The activities carried out align with those (Mursyd et al., 2020; Umairo & Nurmiati, 2020), who also use the ADDIE Method in developing biology teaching materials. In the second stage, researchers assigned students to select plastic waste; where this task is essential because plastic waste is one of the most produced waste, and it can be seen that almost all household products are wrapped in plastic. Food and beverages are also wrapped in plastic.

In the third stage, at this stage of development, researchers strive to compile and edit teaching materials that follow the needs of students and the material to be taught. Researchers also pay attention to the syntax of the creative problem-solving learning model so that the developed teaching materials follow the research objectives.

The fourth stage is implementation, where material and media experts validate feasibility before implementation in classroom learning.

The results of the validation test will be continued with the application of teaching materials in class to find out the practicality of the teaching materials that have been developed. The results of validation tests by material experts can be seen in Table 4 and Table 5. Meanwhile, media experts can be seen in Table 6.

Table 4. Material Expert Validation Results

No.	Assessed Aspects	Material Expert Score	
		1st	2nd
1. ELIGIBILITY OF CONTENTS			
1.1.	Suitability of Material with KI and KD	15	14
1.2.	Accuracy of the Material	28	27
1.3.	Subject matter support	10	10
2. FEASIBILITY OF PRESENTATION			
2.1.	Serving Techniques	8	8
2.2.	Serving Advocates	16	18
3. LANGUAGE			
3.1.	Straightforward	8	8
3.2.	Communicative	8	10
3.3.	Dialogical and Interactive	8	10
3.4.	Compliance with the level of development of learners	4	5
3.5.	Coherent	4	5
	Score	109	115
	Maximum Score	125	125

Table 5. Percentage of Material Expert Validity to Teaching Materials

No.	Information	1st	2nd	Average Percentage of Validity	Validity criteria
		Material Expert	Material Expert		
1. ELIGIBILITY OF CONTENTS					
1.1.	Suitability of Material with KI and KD	100,00%	93,33%	96,67%	Highly Valid
1.2.	Accuracy of the Material	86,67%	90,00%	88,33%	Highly Valid
1.3.	Subject matter support	100,00%	100,00%	100,00%	Highly Valid
2. FEASIBILITY OF PRESENTATION					
2.1.	Serving Techniques	80,00%	80,00%	80,00%	Highly Valid
2.2.	Serving Advocates	80,00%	90,00%	85,00%	Highly Valid
3. LANGUAGE					
3.1.	Straightforward	80,00%	90,00%	85,00%	Highly Valid
3.2.	Communicative	80,00%	100,00%	90,00%	Highly Valid
3.3.	Dialogical and Interactive	80,00%	100,00%	90,00%	Highly Valid
3.4.	Compliance with the level of development of learners	80,00%	100,00%	90,00%	Highly Valid
3.5.	Coherent	80,00%	100,00%	90,00%	Highly Valid
	Average Media Expert Ratings			89,50%	Highly Valid

Table 6. Percentage of Media Expert Validation of Teaching Materials

NO	ASSESSED ASPECTS	Percentage of Validity		Average Percentage of Validity	Validity criteria
		1st	2nd		

1	Module Size	80,00%	100,00%	90,00%	Highly Valid
2	Cover Design	95,00%	80,00%	87,50%	Highly Valid
3	Module Content Design	87,06%	87,06%	87,06%	Highly Valid
Average Media expert assessment				88,19%	Highly Valid

The results of the N-Gain score test calculation in Table 6 show that the average N-gain score for classes using Bio-entrepreneurship teaching materials is 61,267 or 61.27%, included in the moderate effective category, with a minimum N-gain value of 16.67% and a maximum of 100%.

Table 7. N-Gain Score Calculation Results

Information	N-Gain	Criteria
Average N-gain Value	61,27	moderate effective
Maximum N-gain Value	100,00	-
Minimun N-gain Value	16,67	-

Bio-entrepreneurship Teaching Materials Based on Creative Problem Solving developed have followed the ADDIE model development model (Tegeh et al., 2020): Analysis, Design, Development, Implementation, and Evaluation. The Development Stage analyzes the need for Bio-entrepreneurship teaching materials by integrating plastic waste processing materials into financial products taught with the Creative Problem-Solving model. It is hoped that through the modules developed, it can also train and internalize eco-literation.

The results of material expert validation obtained information that the modules developed have met the indicators of content feasibility, presentation feasibility, and language, obtaining an average score of 89.50% with excellent categories. Meanwhile, the results of the media expert validation assessment of teaching materials, including module size, cover design, and module content design, received an average score of 88.19% with an excellent category. The validation results align with the practicality assessment results carried out by material and media experts, where the results obtained from the modules developed are categorized as practical. The assessment results become the basis for the application or implementation stage of the module in the classroom.

The results of implementing the Bio-entrepreneurship module obtained an average N gain score for classes using Bio-entrepreneurship teaching materials of 61,267 or 61.27%, included in the category of quite effective. Based on the results of the implementation carried out by students, it is known that students of the biology education study program already have a reasonably high eco-literation ability.

Eco-literation is also b a conscious attitude towards the environment, consciously protecting it according to their knowledge (Putri et al., 2019). People who know eco-literation can be prepared to create a compelling and sustainable community with all their heads, heart, hands, and soul. They already have an organic understanding of the world and participatory actions in protecting the environment (McBride et al., 2013). This opinion aligns with the results of eco-literation-oriented bio-entrepreneurship learning after gaining basic knowledge about plastic waste and waste processing technology. Students are expected to be able to design and develop creative economy businesses by utilizing recycled plastic residual products.

Teacher skills in learning activities are determined by the extent to which teachers are willing to develop and can keep up with change. Teacher skills affect students' comfort in interconnecting in the learning process (Handayani, 2020). Similar opinions were conveyed (Septikasari & Frasandy, 2018); good teachers who can master the learning process with the right learning strategies will provide positive results for student activities, especially in building critical thinking, creativity, and student innovation. Therefore, teacher learning and learning strategies in the learning process will affect the effectiveness

of learning outcomes. Meanwhile, students who master ecological literacy in biology must actively develop problem-solving and critical thinking skills.

Eco-literacy can bridge cultural development and concern for the natural environment. Meanwhile, according to the study results (Anggraini et al., 2022), the PBL learning model affects increasing students' environmental literacy abilities. Concern for the environment can also be built through classroom learning. This opinion is supported by research results (Habibie, 2020) which state that environmentally responsible behavior is highly dependent on environmental knowledge and self-efficacy, both partial and simultaneous. Environment-based learning has a positive impact and can motivate students' curiosity about what is happening in the environment (Fitriati et al., 2019). It can foster an attitude of care and environmental responsibility (Jeramat et al., 2019).

Conclusions

Teaching materials for Bio-entrepreneurship Teaching Materials Based on Creative Problem Solving have validity and practicality with very valid categories so that teaching materials for Bio-entrepreneurship Teaching Materials Based on Creative Problem Solving meet the validity criteria and are suitable for use in lectures. Bio-entrepreneurship Teaching Materials Based on Creative Problem Solving are quite effective for use in lectures and can develop the eco-literation skills of the Biology Education Study Program students.

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