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Validation of an Ethno-Science-Based PBL Model for Inspiring Entrepreneurial Mindsets in Biotechnology

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Abstract. *The Faculty of Teacher Training and Education at Universitas Serambi Mekkah University is one of the oldest universities in the city of Banda Aceh. Therefore, in implementing the Tri Dharma of Higher Education, lecturers are obliged to carry out research in various fields. To develop this research, the researcher focused on developing the Project-Based Learning (PBL) model. This research aimed to determine the validity of the results of developing an ethnoscience-based biotechnology module within the PBL model, which is used to increase student interest in entrepreneurship in the chemistry education program at Universitas Serambi Mekkah. The development of the PBL model was adapted from the ADDIE model. Based on validation analysis research on the ethnoscience-based biotechnology module using the PBL model, it was found that it can increase students' interest in entrepreneurship. This was developed using the ADDIE method and validated through a test using an instrument sheet with a Likert scale by three experts (validators). The assessment looked at categories such as the quality of learning material, content, language use, module conformity, and physical quality of the module. The assessment obtained an average score from the three validators of 3.30, with the valid category (can be used without revision). Thus, this ethnoscience-based biotechnology module using the PBL learning model can increase the entrepreneurial interest of chemistry education students.*

Keywords: *project-based learning model, ADDIE method, and biotechnology*

1. Introduction

Biotechnology is a field that links the development of science and technology, serving as a bridge for students to master these areas and improve their ability to adapt to technological changes (Sari, 2017). Biotechnology will continue to develop and is essential for providing solutions to future problems in food and health. To help students achieve graduation competency standards, breakthroughs and improvements are needed in both teaching materials and learning innovations. The learning process should be interactive, inspiring, and enjoyable to improve learning outcomes and interest in entrepreneurship, applied directly to everyday materials (Sabri, 2010).

Based on needs analysis and preliminary studies conducted in the odd semester of 2023/2024, the biotechnology course has not produced many fermentation products. This is due to the lack of available time, as lecturers primarily assign independent and group tasks without providing guidance, focusing only on the material they provide. Additionally, students have not participated in MSME activities organized by the Faculty. The application of the Project-Based Learning (PBL) model in ethnoscience-based biotechnology material has not yet been implemented in universities. To engage students in understanding biotechnology material, they must actively build new knowledge by relating it to their everyday environment.

Biotechnology materials are often found in everyday life, such as tempeh, soy sauce, *tauco*, vegetable dishes, pickled fruit, cheese, beer, and others. Biotechnology

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involves applying various sciences by utilizing living organisms or their parts to produce products aimed at human welfare (Nurhidayati, 2017). These materials can be sourced from local wisdom (ethnoscience) and integrated into biotechnology courses. For example, Asam sunti, derived from starfruit, is a typical Acehnese cooking spice produced through fermentation involving microorganisms (Anggraini et al., 2021). Biotechnology materials are widely available in everyday life and can be efficiently developed through module development.

The Ministry of National Education (2008) explains that modules are printed teaching materials designed for independent study by students. To facilitate the use of modules in learning, development is necessary. The application of Project-Based Learning (PBL) in the teaching and learning process is crucial for improving students' critical thinking skills and fostering a sense of independence in learning. As a form of constructive learning, PBL provides real problem situations for students, leading to lasting knowledge. PBL is a model that organizes projects in learning (Gülbahar & Tinmaz, 2006; Rais, 2010). It offers opportunities for a more collaborative system where students actively complete projects independently and work together in teams, integrating real and practical problems.

To enhance learning and understanding of ethnoscience-based biotechnology material, it is essential to use innovative learning methods in developing modules using a Project-Based Learning approach. This approach can attract students' entrepreneurial interest as expected. The problem formulation is how lecturers and students respond to the development of ethnoscience-based biotechnology modules using the Project-Based Learning (PBL) model

2. Method

The type of research used is Research and Development (R&D). The model developed in the research is adapted from the ADDIE (Analyze, Design, Develop, Implement, and Evaluate) model, with development stages consisting of: 1) Needs analysis, 2) Initial Prototype Design, 3) Validation, 4) Revision, 5) Small class trial, 6) Revision, 7) Large trials, and 8) Final product review.

Data were obtained through initial observations and interviews related to entrepreneurial interests by exploring regional potential. The findings at the research stage can be used as guidelines in the design stage of ethnoscience-based biotechnology modules with the Project-Based Learning (PBL) model, which has been validated by experts in the field. After the ethnoscience-based biotechnology module is validated for use, the design is tested in both small and large classes to assess its practicality and effectiveness. The following outlines the data analysis for the validity and effectiveness of the initial PBL module.

a. *Validation Analysis*

Based on the results of the initial module validation (prototype) of the PBL model by experts, the average value given by the validators is determined. The average validity value of the initial prototype is then determined by referring to the value interval as shown in Table 1.

b. *Effectiveness Analysis*

The initial prototype of the PBL model is considered effective if practitioners (lecturers), based on their experience, assess that the initial prototype is effective and is

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implemented effectively in the learning process. Indicators of effectiveness include achieving the goal of developing the PBL model, which is to improve the understanding and processing of regional products, such as 'Asam Sunti' (dried Bilimbi), into marketable products and to increase students' interest in entrepreneurship

Table 1. Validity criteria

Interval	Criteria
$3.2 \leq M \leq 4.00$	Can be used without revision
$2.50 \leq M \leq 3.25$	Can be used with minor revision
$1.75 \leq M \leq 2.50$	Can be used with major revision
$1.00 \leq M \leq 1.75$	Cannot be used

3. Results and Discussions

The development of the PBL learning model includes the following stages: 1) presenting the problem, 2) planning and forming study groups, 3) scheduling, 4) observing product creation, 5) conducting assessments, and 6) evaluation. This process results in various learning tools, such as model books, biotechnology modules, practicum guides, and Semester Learning Plans (RPS). It also produces data collection instruments, including student response questionnaires, interest surveys, and assessment rubrics.

The PBL guidebook (Lecturer's book) is designed to assist lecturers in managing the learning process effectively. The biotechnology module helps students understand conventional and modern biotechnology, fermentation, and microorganisms, which are essential for creating innovative products with high market value. In addition, the learning plan is designed to guide lecturers in conducting the learning process effectively.

To understand the development of an Ethno-Science-Based Project-Based Learning (PBL) Model in a Biotechnology Course, a validation sheet is used in the form of an assessment questionnaire which is filled out by validators, namely lecturers in the Biotechnology course at FKIP, FP Universitas Serambi Mekkah, and FKIP USK totaling 3 people, where it is hoped that the development of biotechnology modules that are made to be usable. Based on calculations from the validation sheet using a Likert scale, the average validation result of the biotechnology module by 3 validators was 3.30 (the module can be used without revision) where from the results of the average score for the material in the biotechnology module by 3 validators, namely, 1) suitability learning materials 2.78. 2) Content 3.5, 3) Language, 3.22, 4) module construction 3.33, and 5) physical quality of module 3.60.

Table 2. Recapitulation Results of Biotechnology Module Validation

No.	Assessment Aspects	Validator 1	Validator 2	Validator 3	Average (M)	Information
1.	Sustainability of learning material	2,83	3,33	2.16	2,78	Can be used with minor revision
2.	Content	3,0	4,5	3,0	3,5	Can be used without revision
3.	Language	3,0	3,67	3,0	3,22	Can be used without revision

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No.	Assessment Aspects	Validator 1	Validator 2	Validator 3	Average (M)	Information
4.	Module construct-ion	4,0	3,67	2,33	3,33	Can be used without revision
5.	Physical quality of the module	3,33	4,0	3,67	3,67	Can be used without revision
	General assessment				**3.30**	**Can be used without revision**

4. Conclusions

The development of the Project-Based Learning (PBL) model resulted in a structured learning process consisting of the following stages: 1) presenting the problem, 2) planning and forming study groups, 3) scheduling, 4) observing product creation, 5) conducting assessments, and 6) evaluation. This development produced four key products: PBL model books, biotechnology modules, practicum guides, and Semester Learning Plans.

The ethnoscience-based biotechnology module developed within the PBL model was validated by three experts, achieving a mean validation score of 3.30, indicating that it is valid without revisions needed

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