

## PBL-STEM Module Feasibility Test for Pre-service Biology Teachers

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### Abstract

Life skills are needed in this era of globalization to be successful in the school environment or outside of school. According to the 2019 World Economic Forum, the world's demand for STEM qualifications and skills is very high now and is likely to continue to increase in the future. Today, 75% of the fastest-growing industrial-scale jobs require skilled STEM workers. Faced with this, to be able to compete, the world of work requires people who can adapt to their new work environment. STEM can empower individuals with the skills to succeed and adapt to new work environments. To get individuals who have STEM skills, individuals who have 21st-century skills are needed. This is because in 21<sup>st</sup>-century skills 3 skills must be met, namely learning skills, reading and writing skills, and life skills. The purpose of this study was to determine the feasibility of the PBL-STEM module developed for prospective Biology teacher students as an effort to improve 21st-century skills. The method used was the Rosset-based RnD ADDIE model. The ADDIE Teaching Model includes 5 stages, namely analysis, design, development, implementation, and evaluation. The results of the material expert validation show that the average score of the material expert validation results shows a fairly good category with an average of 2.94. The results of practitioner validation show that the average score of practitioner validation results shows a good category with an average of 3.56. The results of the small group readability test showed that the average score on the small group readability test was in the good category with an average score of 3.39.

**Keywords:** 21<sup>st</sup> century skills feasibility test, PBL-STEM module, new work environments, pre-service biology teachers

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## 1. Introduction

Life skills are needed in this era of globalization to be successful in school and outside of school. Currently, the world's demand for STEM qualifications and skills is very high and is likely to increase even further in the future (WEF, 2018a). Currently, 75% of

the fastest-growing industrial-scale jobs require workers with STEM skills (WEF, 2018b). In the face of this, to be able to compete, the world of work needs people who can adapt to their new work environment. And STEM can empower individuals with the skills to succeed and adapt to new work

environments. To get individuals who have STEM skills, individuals who have 21st-century skills are needed. This is because in 21st-century skills 3 skills must be met, namely learning skills, reading and writing skills, and life skills.

In learning skills, individuals are required to be able to think creatively, think critically, communicate, and collaborate well. As for reading and writing skills, each individual has been equipped since elementary school, and life skills will be obtained when they go directly to the community with the assumption that they can succeed or fail. Applications in the community will be maximally successful if individuals often practice directly (Widanti, 2020). However, hands-on practice is also not enough, as to qualify individuals for any form of contingency, work experience skills, or project or problem based learning experiences are required. Problems in learning in this era of independent learning require a directed solution (Suryawati, 2020). Based on the description above, it can be said that to get individuals who can compete in the global market, individuals who have 21st-century characteristics are needed. Individuals with 21st-century characters can be obtained if these individuals have STEM skills. Whereas in reality, the application of STEM in Indonesia is currently still minimal. This can be seen from the results of research on STEM in the last five years, from 2015 to 2019 (Setyaningsih et al, 2021).

STEM-based science education demands a shift in the mode of the learning process from the conventional mode, namely teacher-centered, which relies on knowledge transfer, to a student-centered learning model that relies on student activity, direct practice, and collaboration. STEM-based science learning needs to be applied in problem-based learning units, where students are challenged critically,

creatively, and innovatively to solve real problems, which involve collaborative group (team) activities. STEM-based science learning in the classroom is designed to provide opportunities for students to apply academic knowledge in the real world (Rustaman, 2016).

The application of knowledge in the real world is carried out by educators using various learning models. Each learning model has a focal point in its application, such as problem poisoning learning which puts more emphasis on the application of critical thinking (Christidamayani and Kristanto, 2020), then project-based learning which emphasizes treatment through mini-projects, problem-based learning which places more emphasis on raising problems. to find solutions and many other learning models.

PBL in particular is problem-based learning. The problems that exist are sourced from the reality around and challenge students so that students can identify. In PBL, the learning process takes place by giving problems which are then identified problems with the aim of students identifying problems that are relevant to the subject matter, then one of them is selected and formulated in the form of a hypothesis. After the identification process is continued with data collection, which will then be processed and checked whether the established hypothesis is true or not with alternative findings and is associated with the results of data processing. Based on this process, the PBL learning model is carried out systematically by building student skills through problem solving, identification, and solutions provided in solving problems (Adiguna, Dantes, & Gunamantha, 2019). Based on this description, the PBL model is suitable to be integrated with the STEM approach.

In the application of the PBL learning model integrated with STEM, it is necessary

to have learning media that can make students enthusiastic and motivated to carry out learning activities. One of the learning media that can be used in active learning is the module. The teaching and learning module (PBM) is a PBM reference material that is made to explain the syllabus that has been set in the curriculum. Modules at this time, there are already 2 kinds of forms, namely e-modules and modules. E-modules are often known as virtual modules, which can be accessed via PC, laptop, or android. In this digital era, interactive modules that can be accessed via Android are preferred by students. This is probably because it is something new and unique, and it is very fun to use because many colorful animations or images motivate students to feel at home in reading the e-module (Zamhari et al, 2022). As for the module, it is a learning media that is physically present in the form of sheets that are covered together like a book that can be held in real-time.

The purpose of this study was to determine the feasibility of the PBL-STEM module which was developed for prospective Biology teacher students as an effort to improve 21st-century skills

## **2. Method**

This research was carried out from January to August 2021 at the Biology Education Study Program, FKIP UMS for students taking Microteaching courses during the semester. Even the 2020/2021 Academic Year. This research is a Research and Development (RnD) by adapting the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The product developed is an integrated STEM Problem Based Learning (PBL) learning module.

In the analysis stage, the steps taken are needed analysis which includes literature studies and field studies. The literature study

was conducted by reviewing the literature and the results of previous research on the development of an integrated PBL STEM module. Field studies are carried out using observation, reviews of existing and currently used products, and interviews.

The design phase includes initial product design and preparation for initial product development. At this stage, several activities are carried out such as determining both learning and product development goals, determining parties related to research and development, and determining work procedures and product feasibility tests.

The development stage includes initial product development, first expert validation, product revision, and second expert validation. The product developed is a STEM integrated PBL learning module. After the draft of the STEM integrated PBL learning module is produced as the initial product, validation (expert review) is carried out. Expert validation consists of material and learning design experts as well as practitioner validation (course lecturers). The results of the first validation then become the basis for the initial product revision. The results of the initial product revision were then re-validated in the second expert validation.

## **3. Result and Discussion**

Microteaching is a teaching exercise as an effort to prepare the ability of prospective teachers or to improve the ability of teachers to deal with complex and simplified learning tasks (Sukirman, 2012). This research is development research that aims to develop a PBL-STEM learning module for prospective Biology teacher students in microteaching courses. The development stage is limited to the small-scale field trial stage.

The trial was conducted in the form of a limited trial consisting of several stages, namely material expert validation (PBL-

STEM), practitioner validation (microteaching lecturers), and a small group readability test.

The data obtained at the material expert validation stage are in the form of assessments, opinions, and suggestions on the suitability of the material contained in the module, in this case, the accuracy of PBL-

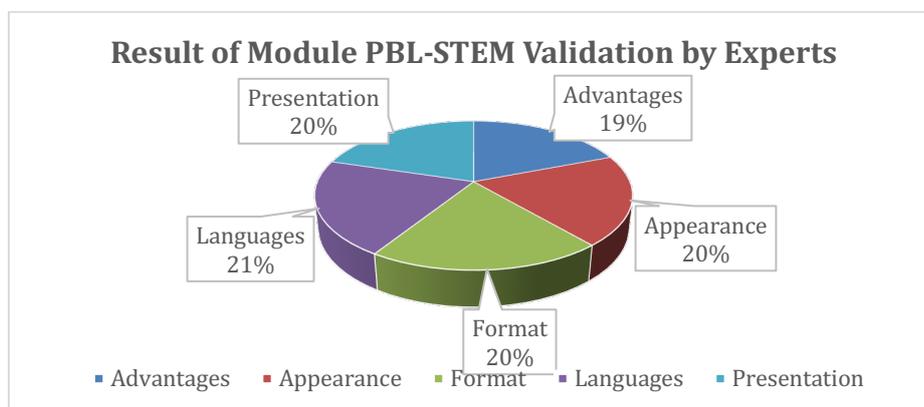
STEM integration in the Microteaching course and ensuring that the material in the module is scientifically correct. The results of material expert validation on the PBL-STEM module are presented in Table 1. Table 1 shows that the average total score of the material expert validation results shows a good category with a score of 2.94.

**Table 1. Data Validation of Material Experts**

Aspect	Score	Category
Conformity with the principles of developing teaching materials	2.00	Good Enough
Content Feasibility	2.50	Good Enough
Language	4.00	Very Good
Presentation	3.00	Good
Graphics	3.25	Good
<b>Medium</b>	<b>2.94</b>	<b>Good</b>

If seen from each aspect of the validation, which was assessed as the very good namely the use of language in the module with a score of 4 round category good seen in the module presentation and the graphic images used in the module with a score of 3 and 3.25. Then the score is quite good, from the validator stating that the aspect of conformity with the principles of developing teaching materials

and also in the content section, shows a score of 2 and 2.5. From the total results of the validation of the module material by experts, it can be concluded that the PBL-STEM module is feasible and can be used in teaching microteaching. The distribution of the PBL-STEM module validation scores by experts can be seen in Figure 1.



**Figure 1. The Results of the Validation of the PBL-STEM Module by Experts**

The feasibility of the data obtained from the validation results of the Microteaching

lecturers in the form of opinions, suggestions, and criticisms of the developed module

adjusted to the characteristics of the Microteaching course with PBL-STEM integration in learning activities. The results of practitioner validation are presented in

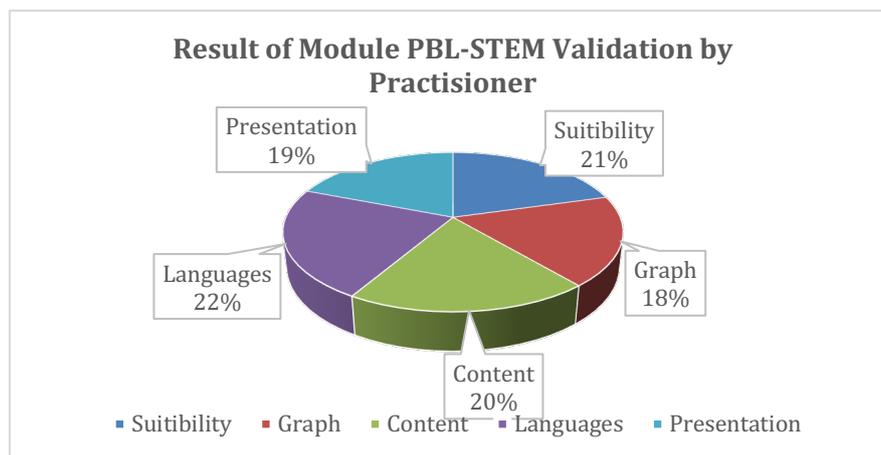
Table 2. Table 2 shows that the average score of practitioner validation shows a good category with an average score of 3.56.

**Table 2. Validation of Experts on Data**

Aspect	Score	Category
Conformity with the principle of developing teaching materials	3.67	Very Good
Content Feasibility	3.50	Good
Language	4.00	Very Good
Presentation	3.40	Good
Graphics	3.25	Good
<b>Moderate</b>	<b>3.56</b>	<b>Good</b>

When viewed from each aspect of the validation by the practitioner, which was assessed in the very good name on the use of language and the principle of conformity with the development of teaching materials in the module with a score of 4. category good seen in the content feasibility presentation of the module, and graphic images used in the module with a score of 3.40 and 3.25. Then

the value is quite good, nothing. From the total results of module validation by practitioners, it can be concluded that the PBL-STEM module is feasible and can be used in teaching microteaching. The distribution of the PBL-STEM module validation scores by practitioners can be seen in Figure 2.



**Figure 2. PBL-STEM Module Validation Results by Practitioners**

After going through the expert validation stage, the module was tested in a readability test stage small group. The small group readability test aims to identify and correct the most glaring errors in the module such as

typos, letter errors, image placement errors, etc. as well as to assess the clarity of the content, whether it is easy to understand, easy to understand, attractive appearance, and legibility. The small group readability test

was conducted on 15 students who had taken the microteaching course. The results of the small group readability test are presented in

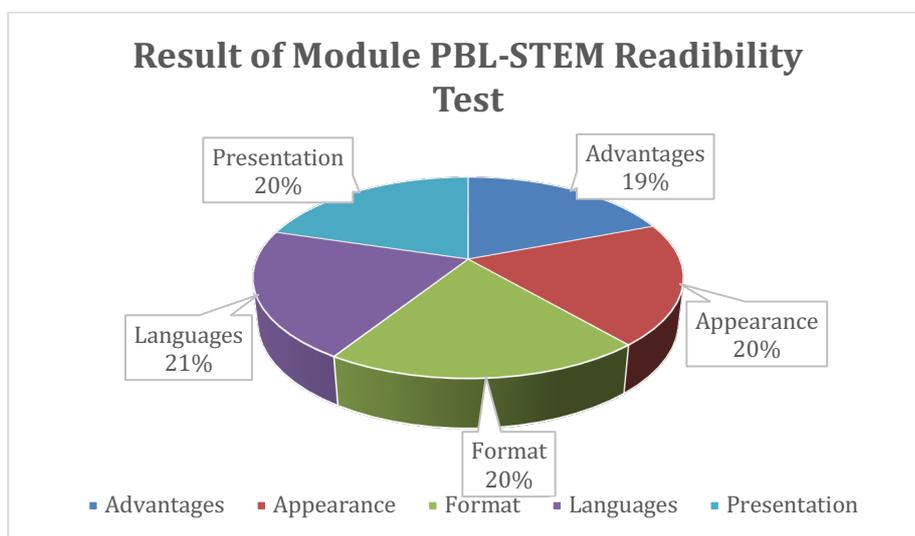
Table 3. Table 3 shows the average score on the small group readability test is in the good category with an average score of 3.39.

**Table 3. Data of Small Group Readability Test Results**

Aspect	Score	Category
Learning module format	3.44	Good
Language used in the module	3.52	Good
Presentation of a learning module	3.45	Good
Display of learning module	3.33	Good
Benefits of the module in developing 21st-century skills	3, 25	Good
<b>Moderate</b>	<b>3.39</b>	<b>Good</b>

When viewed from each aspect of the readability test validation by small groups, none are assessed in the very good categories good seen in the format module language, module display, presentation of the module, and the benefits of the module used in the module with a score from 3.25 to and 3.52. Then the value is quite good, nothing. From

the total results of the module limitation test by small groups, it can be concluded that the PBL-STEM module is feasible and can be used in teaching microteaching. The distribution of the PBL-STEM module validation scores by practitioners can be seen in Figure 4.



**Figure 3. Results of the PBL-STEM Module Readability Test**

Data from material experts, practitioners, and small group readability tests were analyzed descriptively with the percentage

technique to obtain an assessment percentage to get test decision. The summary of test data analysis is presented in Table 4.

**Table 4. Results of Trial Data Analysis**

Phase	%	Category	Decision
Material Expert Validation	73.50	Good	Revision
Practitioner Validation	89.00	Very Good	No Revision
Small group readability test	84.75	Very Good	No Revised
<b>Average</b>	<b>82.41</b>	<b>Very Good</b>	<b>No Revised</b>

Based on Table 4 it is known that in general when viewed from the average percentage of assessment, the PBL-STEM Module is in the very good category with an average percentage of 82.41, and the decision the test is not revised. However, based on suggestions from material experts and practitioners, the module was improved to further improve the quality of the developed module.

STEM-based science education demands a shift in the mode of the learning process from conventional teacher-centered modes, which rely on knowledge transfer, to student-centered learning modes, which rely on activeness, hands on, and students. Collaboration. STEM-based science learning needs to be applied in problem-based learning units, where students are challenged critically, creatively, and innovatively to solve real problems, which involve collaborative group (team) activities. STEM-based science learning in the classroom is designed to provide opportunities for students to apply academic knowledge in the real world (Rustaman, 2016).

PBL is problem-based learning. The problems that exist are sourced from the reality around and challenge students so that students can identify. In PBL, the learning process takes place by giving problems which are then identified problems with the aim of students identifying problems that are relevant to the subject matter, then one of them is selected and formulated in the form of

a hypothesis. After the identification process is continued with data collection, which will then be processed and checked whether the established hypothesis is true or not with alternative findings and is associated with the results of data processing. Based on this process, the PBL learning model is carried out systematically by building student skills through problem-solving, identification, and solutions provided in solving problems (Adiguna, Dantes, & Gunamantha, 2019). Based on this description, the PBL model is suitable to be integrated with the STEM approach.

The success of learning by integrating PBL-STEM is determined by the ability of teachers to design and implement PBL-STEM-based learning. Therefore, prospective Biology teacher students need to be trained to design and implement PBL-STEM-based learning. The development of this module has a target so that prospective teacher students can integrate PBL-STEM in microlearning design.

#### **4. Conclusion**

The results of the material expert validation show that the average score of the material expert validation results shows a fairly good category with an average of 2.94. The results of practitioner validation show that the average score of practitioner validation results shows a good category with an average of 3.56. The results of the small group readability test showed that the average

score on the small group readability test was in the good category with an average score of 3.39.

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