THE DEVELOPMENT OF SCIENTIFIC-BASED E-MODULES TO IMPROVE CONCEPTUAL UNDERSTANDING OF NUTRITION STUDENTS IN BIOTECHNOLOGY SUBJECTS

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Abstract: The purpose of the study was to develop scientific-based E-Modules in biotechnology courses. This type of research is an R&D research with the 4D method. The research sample involved 30 Nutrition students, Muhammadiyah University of Bima. The results showed that the E-Module developed had a high level of feasibility with a percentage ranging from 86.93% with a very good category. This shows that the developed E-MODUL is suitable for use as teaching material in biotechnology courses. The developed E-MODUL has characteristics that are simple, flexible, interactive, usability, reusable, maintainable, and easily accessible by lecturers and students. The implication is that the developed E-Module can be accessed by students and lecturers of the nutrition study program, bima muhammadiyah university. There is a need for development by involving augmented reality, so that the presentation is based on factual phenomena.

Keywords: Biotechnology, E-Modules, Google Sites

INTRODUCTION

Biotechnology is a branch of biology that studies the application of organisms, microorganisms, and macroorganisms. Traditional biotechnology, or what we call conventional biotechnology, actually dates
back to the 19th century, such as the production of beer and bread using the principle of fermentation. Biotechnology utilization is growing very rapidly. Biotechnology is a branch of science that studies the use of living organisms (bacteria, fungi, viruses, etc.) and derivative products of living organisms (enzymes, alcohol) in the production of goods and services. Biotechnology courses in the gii study program are expected to create superior nutritional supply food products. Biology courses are often considered factual material because they involve microorganisms and macroorganisms that are difficult for students to understand. It is necessary to have the right means of delivering information to support students' conceptual understanding. One of the efforts that can be made is to facilitate students with interactive learning media such as e-modules.

Electronic modules are an example of e-educational materials that fall into the category of interactive educational materials because they combine text, images and video and require user control to use. The learning experience with media is seen as a complex interaction between cognitive and affective aspects (Harris et al. 2022; Hendra Sofyan, Evita Anggereini 2019; Klentien and Wannasawade 2016; Koehler et al. 2013; Shoaf et al. 2022).

E-modules are also equipped with practicum simulations and students can find out learning completeness through interactive self-evaluation (Herawati and Muhtadi 2018; Sugihartini and Jayanta 2017). The high level of flexibility and portability that e-modules have, as well as ease of use, so that they can present material phenomena and the process of an event that is difficult to observe directly. (Charlina et al. 2022; Herlina, Zetia, et al. 2022; Noris, M., Saputro, S. 2021; Noris et al. 2023; Pramana, Jampel, and Pudjawan 2020).

The selection of E-Modules as an interactive learning tool is also based on the Cognitive-Affective Theory of Learning with Media (CATLM) according to (Moreno, 2006). According to (Moreno, 2006) the use of media in learning can affect student understanding, retention, and engagement. Learning media should be designed with cognitive and affective aspects in mind to help create a more effective and engaging learning experience (Miftakhirrohmah et al. 2023; Noris, M., Saputro, S. 2021; Noris, M., Sulistyo Saputro 2023). The learning experience with media is seen as a complex interaction between cognitive and affective aspects. Cognitive processes include receiving, processing and storing information in memory. Meanwhile, affective aspects include students' feelings, motivation and attitude towards learning. (Wahyuni, Sudarisman, and Karya 2013).

Conceptual understanding of nutrition students, Muhammadiyah Bima University is still relatively low in basic biology courses, especially on the topic of biotechnology. This is the fundamental reason for the
need for interactive learning media in the form of E-Modules. In addition, the use of E-MODUL is considered effective in delivering biotechnology material to improve students' conceptual understanding. Therefore, this study aims to develop a scientific-based E-MODUL to improve students' conceptual understanding in biotechnology courses.

METHODS

This type of research is research and development (R&D). This research is a qualitative research by developing Scientific-based E-MODUL in biotechnology courses. The development method refers to the 4D development stage which includes the Define, Design, Develop, and Disseminate stages.

This research was conducted at the University of Muhammadiyah Bima. The research sample consisted of 30 students in the biology topic biotechnology course.

In the scientific-based E-Module development research, material, media, and language validation was carried out involving 2 external validators. The validation results were then calculated with Aiken's validity. The following are the eligibility criteria for scientific-based E-MODUL, which are as follows:

<table>
<thead>
<tr>
<th>Score (%)</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>81-100</td>
<td>Very Good</td>
</tr>
<tr>
<td>61-80</td>
<td>Good</td>
</tr>
<tr>
<td>41-60</td>
<td>Pretty Good</td>
</tr>
<tr>
<td>21-40</td>
<td>Less Good</td>
</tr>
<tr>
<td>0-20</td>
<td>Not Good</td>
</tr>
</tbody>
</table>

Table 1. Criteria for the feasibility of scientific-based E-Modules
The following is a detailed explanation of the 4D development method which includes the Define, Design, Develop, and Disseminate stages, as shown in Figure 1.

**Figure 1.** The flow of the scientific-based E-Module development design.

### RESULTS AND DISCUSSION

#### Define Stage

At this stage, a front-end analysis was carried out by conducting observations and inclusive interviews with nutrition lecturers, faculty of health, Bima Muhammadiyah University on biotechnology material. The results of the analysis show that the implementation of the learning model in biotechnology courses is still conventional and monotonous. This is evidenced by the learning instrument used only based on PPT with lecture method. Then student analysis is carried out related to student conceptual understanding of biotechnology material. The results of the
analysis show the low conceptual understanding of students on the concept of biotechnology learning.

Based on the results of observations and inclusive interviews with lecturers and nutrition students, there is a need for scientific-based learning media innovations such as E-Modules.

**Design Stage**

At this stage, scientific-based E-MODUL development is carried out by determining the E-Module prototype to be developed, the software to be used (Google Sites), maintenance level resistance (Usability, Reusable, maintainable, compatibility, interactive, and effectiveness). The components designed consist of a home page, aspects of biotechnology material, and a profile of the Scientific-based E-MODUL media developer.

The high level of flexibility and portability that e-modules have, as well as ease of use, so that they are able to present material phenomena and the process of an event that is difficult to observe directly. The components that must be in the E-Module according to (Sunday, Rampisela, and Sahertian 2022) yakni sebagai berikut:

a. Home, which is a menu that contains links and material profiles in the emodule.

b. Instructions for use contains guidelines on how to use the e-module.

c. Learning objectives are elaborated into learning indicators.

d. Learning instructions, containing an efficient explanation of how to organize learning.

e. The material page consists of material descriptions that contain concepts.

f. Process page, the aspects are images, animations, or videos that have a relationship with the material presented.

g. The learning evaluation page contains tests that refer to the targeted learning objectives. On this page, the answer key and feedback on the learning evaluation results are also presented.

At the stage of selecting the format of the scientific-based E-Module to be developed, determining the software to be used, and selecting a distribution method that is easily accessed by lecturers and students.

**Develop Stage**

At this stage, the E-Module validity test was carried out to determine the feasibility level of the E-module so that it could be used in learning. The results of the analysis show that the E-Module developed is
feasible to use as a learning media with a percentage ranging from 86.98% with a very good category. This can be seen in the table below:

<table>
<thead>
<tr>
<th>Aspects assessed</th>
<th>E-Module Validity</th>
<th>Percentage (%)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media</td>
<td></td>
<td>80.34</td>
<td>Good</td>
</tr>
<tr>
<td>Material</td>
<td></td>
<td>90.25</td>
<td>Very Good</td>
</tr>
<tr>
<td>Language</td>
<td></td>
<td>90.35</td>
<td>Very Good</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>86.98</td>
<td>Very Good</td>
</tr>
</tbody>
</table>

After obtaining the validity of the E-MODUL, then the developed E-module can be used as teaching material in biotechnology courses. The availability of laboratory resources is limited and not always available, so the need for innovation to support learning activities that require practicum, E-Modules are considered the best solution that can meet the needs of students (Alneyadi 2019). The following are the results of the scientific-based E-MODUL development stage, which are as follows:

![E-MODULE Home View](image)

**Figure 2. E-MODULE Home View**

On the E-Module homepage, the title, brief description, and developer profile of the scientific-based E-MODU used in biotechnology courses are presented.
In this display, it is presented about the application of biotechnology utilization accompanied by images. In the image display, the URL of each journal is attached which can be accessed by students to support their initial knowledge of biotechnology utilization trends.

On this display are attached related to the principle definition of biotechnology, the history of the development and utilization of biotechnology, as well as the application and application of biotechnology that can be accessed by students via YouTube videos. The goal is that students in addition to reading are also empowered with scientific-based videos that can encourage student attention and perceptions of learning biotechnology courses.
This display includes a view of access to international-based journals that can be accessed by students at MDPI (https://www.mdpi.com/). This is done to increase students’ conceptual insights related to world biotechnology.

In this menu, the developer profile menu is displayed, which consists of all lecturers of the bima muhammadiyah university nutrition study program. The reasons for choosing E-modules include the advantages of E-Modules can be displayed visually through digital devices, flexible, effective, and efficient. E-modules were chosen because they can display videos, not just illustrate in the form of images only. (Herlina, Ilmadi, et al. 2022; Howard and Miskowski 2005; Priem et al. 2011). In addition, E-Modules do not require maintenance costs than printed modules.

The electronic module has the advantage that it can be accessed easily by students with an android/laptop. Students do not have to carry
books because they can access a lot of information related to learning in their spare time. E-MODUL encourages students to play an active role in learning (Chen, Huang, and Chen 2017; Kuhlthau, Maniotes, and Caspari 2015; Pedaste et al. 2015).

**Disseminate Stage**

At this stage, dissemination is carried out using WAG (Watshapp grub) which can be accessed by lecturers and students of the nutrition study program, bima muhammadiah university. The developed scientific-based E-Module can be directly accessed on the hosting that is already owned with the link [https://sites.google.com/view/e-modulbiotenologi/beranda](https://sites.google.com/view/e-modulbiotenologi/beranda).

**CLOSING**

The developed E-MODUL has characteristics that are simple, flexible, interactive, usability, reusable, maintainable, and easily accessible by lecturers and students. The results of the validity of the E-Module show a high level of feasibility with a percentage ranging from 86.93% with a very good category. This shows that the developed E-Module is suitable for use as teaching material in biotechnology courses. The implication is that the E-Module developed can be accessed by students and lecturers of the nutrition study program, bima muhammadiah university. There is a need for development by involving augmented reality, so that the presentation is based on factual phenomena.
REFERENCES


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