

# The Development of E-Module Biomolecules for Enzyme Integration of Project Based Learning Models in Accordance With the KKNi Curriculum

Vina Rezekyah Hasibuan<sup>1,\*</sup>, Murniaty Simorangkir<sup>2</sup>, Ajat Sudrajat<sup>3</sup>

<sup>1,2,3</sup>Postgraduate program of Chemistry Education, State University Of Medan, Indonesia

\*Corresponding author. Email: [vina.rezekyah@gmail.com](mailto:vina.rezekyah@gmail.com)

## ABSTRACT

The Development of electronic learning media needs to be done in accordance with technological developments. The purpose of this study is to obtain the integrated enzyme bio molecular electronic module of project based learning models according to the KKNi curriculum in an effort to increase student motivation and competence in biochemical learning. This study is research and development with the ADDIE models. The research instruments were the SNPT validation questionnaire, essay test and student motivation questionnaires. Data were analyzed descriptively and statistically independent sample T test of the two parties SPSS 21 program. Based on the data analysis, The enzyme bio molecular electronic module integrated of the project based learning model has an average value of 3.45 categories which is very valid. E-module bio molecules for enzymes integrated project based learning models according to the KKNi curriculum has been developed. The development process proved successful because it was valid and very suitable for use in the bio molecular learning process. The application of learning packages has proven effective in improving several aspects for students such as learning competence and motivation.

**Keywords:** E-modules, enzymes, project based learning, KKNi curriculum

## 1. INTRODUCTION

The era of globalization demands the development of science and technology. At the same time, the government has made various efforts to improve the quality of education. In line with the National Education Vision, the Ministry of National Education aims to produce intelligent and competitive Indonesians by 2025, so that education is very important in the survival of the nation.

Teaching materials are instructional media that have a dominant role in the classroom and are a central part of the education system. Teaching materials are also important tools for delivering curriculum materials. Teaching materials not only serve as a teaching resource that provides learning material but can also function as a syllabus. Teaching materials provide instructional guides to teachers, which allow teachers to teach without having to look at the syllabus. Thus, the quality of teaching in the classroom is highly dependent on teaching materials. The development of teaching materials must pay attention to the prerequisites of the

competent body, namely the National Education Standards Agency (BSNP) or the National Higher Education Standards (SNPT), and the current curriculum in higher education, namely the Indonesian National Qualifications Framework (KKNi). The KKNi curriculum expects that the profiles of graduates that will be produced from the study program must be described briefly and in detail which will then become the learning outcomes that will be produced by students. Learning outcomes is the internalization and accumulation of knowledge, skills, attitudes, and competencies achieved through a structured educational process covering a particular field of knowledge / expertise or through work experience [1]. Teaching materials help understand the concept of science to achieve the desired competence so that it is easy to remember and can be repeated [2]. Innovative and interactive teaching materials can increase student motivation to learn independently [3]. Utilization of learning resources maximally will be able to explore complete knowledge according to the level of student development [4,5]. Quality teaching materials and instilling character education are one of the efforts to

improve the quality of education [6,7]. The experience of educators is that the existing teaching materials (textbooks) still need a lot of improvement, because the presentation of the material is not perfect, not systematic, the appearance and images are not attractive, and the language is not standardized. This weakness may cause students to be disinterested, bored, resulting in low learning outcomes [8]. This is reinforced by the results of research related to the development of teaching materials which state that there are still many books currently in circulation which are not standard [9-11].

Along with the rapid development of technology as it is today, of course we are familiar with internet technology. Where, the internet can be used as a container as a container for existing learning media or the internet itself can be modified in such a way as to become a learning medium that can support a learning process. One of them is electronic learning (e-learning) based learning media. One of the e-learning that is quite popular is the electronic learning module / e-learning module, this is because it is easy to use and is popular in the community. The development of e-learning modules needs to be done as an effort to overcome current problems. E-books can foster motivation, reduce dependence and achieve learning outcomes in accordance with the indicators of learning tools made by the teacher [12]. Student response to the e-book was very good and the chemistry e-book on the salt hydrolysis material developed was effectively used in learning [13]. The student learning experience significantly increased after using the E book in biochemistry learning [14]. Multi touch e books can improve understanding of subject matter for students and student responses to multi touch e books are very positive [15]. Project assignments are one of the 6 KKNi curriculum tasks, therefore to keep up with the curriculum development it is necessary to develop e-modules which are integrated with project based learning models. Project based learning is a learning strategy that can help students to have creative thinking, problem solving, and interaction and assist in investigations that lead to solving real problems [16]. The project based learning approach effectively improves critical thinking skills, cognitive, activity, creativity, motivation, interest and understanding of students [17-19]. Currently, biotechnology is growing very rapidly. Many factors support this development. One factor is advances in the field of enzymes. Awareness of the importance of this enzyme needs to be raised so that students can follow the development of biotechnology [20].

## 2. RESEARCH METHOD

### 2.1. Research Procedures

The development of an integrated enzyme biomolecule e-module with a project based learning model according to the KKNi curriculum is carried out by following the R & D (Research and Development) procedure. R&D is a research method used to produce certain products and test the effectiveness of these products [21]. The development model in this study is based on the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model. The e-module eligibility validation assessment is used to measure the feasibility level of the e-module that has been developed. The e-module validation assessment used in this study is the SNPT eligibility questionnaire. To measure learning outcomes, standardized tests are used. Tests are arranged based on learning achievement. Motivation questionnaires are given to students to collect data on student learning motivation which is assessed from predetermined aspects and indicators.

### 2.2. Development and Standardization of Innovative Learning Materials

The development of e-modules is carried out by enriching the topic of enzymes in bio molecular subjects integrated with a project based learning model according to the KKNi curriculum to achieve competence, motivate students and find out the correlation. The e-module contains learning materials, learning videos, animations and pictures packed in the form of a flipbook that can be used offline and online, can be applied with desktop and smart phone. Furthermore, in the flipbook, a simple practicum project is given to be carried out at home. The e-module that has been developed is evaluated by four expert validation. to standardize e-module, used a feasibility questionnaire based on the National Higher Education Standardization (SNPT)

### 2.3. Implementation of Innovative Learning Material

Enzyme topics are taught based on timetable schedules in the Department. The trial was carried out in two groups with different treatments. The e-module developed was used as the main learning resource for experimental group I and a biochemistry printed book with separate instructions was prepared for experimental class II. Before treatment, each group was given a

pretest. All students are required to study hard and submit their assignments on time. The experimental group I students were asked to study the enzyme topic and work on the project provided in the e-module, while the experimental group II were asked to study biochemistry printed books on the topic of enzymes with a direct instruction model. The posttest was given at the end of the learning process for both groups. Students were then asked their motivation for studying enzymes.

### 3. RESULT AND DISCUSSION

#### 3.1. The Development of Learning Material

The learning material consists of five sub topics, namely: (1) Classification and Nomenclature of Enzymes, (2) Mechanism of Enzymes, (3) Factors Affecting Enzymes, (4) Isolation and Purification of Enzymes, (5) Application of Enzymes in Various Field. A description of the development of the e-module integration project is summarized in Table 1. The e-module is packaged in a flipbook form stored in an exe file.

**Table 1.** The Description Of Innovation Which Is Integrated And Developed To The E-Module

Topics	Description
Introduction	Animated video short explanation of enzymes and outline of the enzyme material to be discussed.
Classification and Nomenclature of Enzymes	Animated videos, development of teaching materials, integration of images about enzyme classification.
Mechanism of Enzymes	Animated videos, development of teaching materials, integration of images about mechanism of enzymes.
Factors Affecting Enzymes	Practicum videos, development of teaching materials, integration of project based learning.
Isolation and Purification of Enzymes	Animated videos, development of teaching materials, integration of images about isolation and

	purification of enzymes
Application of Enzymes in Various Field	Animated videos and development of teaching materials.

The e-module display that has been developed can be seen in Figure I.

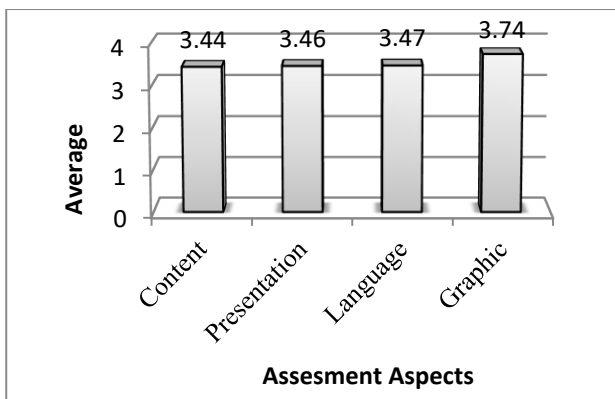


**Figure 1.** Display E-modules

#### 3.2. Standardization of Learning Material

The e-module that has been developed by researchers is subsequently standardized by expert lecturers called expert validation. The expert validation used in this study have a Masters (Strata 2) educational qualification and each is an expert in learning materials, models or media. Expert validation standardize the e-module by using a validated SNPT questionnaire, the same questionnaire is used in the analysis of biochemical printed books.

The results of the project based e-module standardization show that the feasibility of content obtains an average value of 3.44 (very valid), the language feasibility obtains an average value of 3.47 (very valid), the presentation feasibility obtains an average value of 3.46 (very valid) and the mean of graphic feasibility was 3.74 (very valid). Obtained an average value of 3.53 (very valid). Based on the data obtained, it shows that the e-module developed is very suitable for use in learning, and continues to make several revisions to the e-module so that the resulting product can be accepted and used in the teaching and learning process. This is in line with the results of research [22] showed that the development of e-modules obtained very good result. The results of standardization by expert validation can be seen in Figure 2.



**Figure 2.** Graph of the feasibility analysis of the enzyme bio molecule e-module integrated project based learning model according to the KKNi curriculum

### 3.3. Implementation of Innovative Learning Material

The implementation was carried out at the Chemistry Education Study Program, Department of Chemistry, Medan State University which was designated as the research site. The purpose of this stage is to find out which e-modules are effective in improving student learning outcomes. Before testing the hypothesis, the data requirements are tested as a prerequisite for further statistical testing. The increase in student learning outcomes from both classes was obtained from the pretest and posttest results data. The average data on the increase in student learning outcomes from both classes can be seen in Table 2.

**Table 2.** Data on The Improvement of Learning Outcomes In The Experiment I And Experiment II Classes

Class	Evaluation test			
	Pre Test		Post Test	
	Average Score	Normality (Sig.)	Average Score	Normality (Sig.)
Experiment I	24.15	0.053	90.65	0.2
Experiment II	25.20	0.2	78.70	0.2

The average increase in student learning outcomes in the experimental class I was greater than the experimental class II (90>78).

The results of the research on student motivation towards the developed project based e-module were carried out by giving 20 statements. The difference in student learning motivation can be seen from the average value of learning motivation in experimental class I and experiment II. The average value of student learning motivation is shown in Table III.

**Table 3.** Average Value of Student Learning Motivation

No	Indicator	Questionnaire Items	Experiment I (%)	Experiment II (%)
1	Diligent in facing the task	3	89	65
2	Resilient to adversity	4,5,6	83	70
3	Prefer to work independently	2,7	81	66
4	Enthusiastic, don't get bored quickly in following the lesson	8,9,10	83	62
5	Can defend his opinion	1,11,12,13,14,15,16	82	70
6	It is not easy to let go of what is believed	17,18,19	83	70
7	Enjoys finding and solving problems in the form of questions	20	91	28
<b>Total//Average</b>		<b>20</b>	<b>84</b>	<b>62</b>

Based on Table III, it is obtained that the average score of student motivation in experimental class I is higher than the average score of student motivation in experimental class II, this value indicates that students

are motivated by the project based bio molecule enzyme e-module that has been developed.

On average, students provide positive motivation after using e-modules [23]. E-books can foster motivation, reduce dependence and learning outcomes



- [12]. D. K. Andani, M. Yulian, Pengembangan E-modul Electronic Book Menggunakan Software Kvisoft Flipbook Pada Materi Hukum Dasar Kimia di SMA Negeri 1 Pantou Reu Aceh Barat, *Jurnal IPA dan Pembelajaran IPA*, 2(1): pp. 1-6, 2018.
- [13]. B. Kristyaningsih, S. R. Saputro, S. Budi, Pengembangan E-book Kimia Berorientasi Pronlem Based learning (PBL) Pada Materi Hidrolisis Garam Untuk Kelas XI MIA SMA/MA Semester II, *Jurnal Inkuiri*, 4 (1): pp. 131-137, 2015.
- [14]. A. C. Hill, L. M. Nickels, P. A. Sims, Student-Led Development of an Interactive and Free Biochemical Methods eBook, *Journal of Chemical Education*, 93(6): pp. 1034-1038, 2016.
- [15]. J. Franco, B. A. Provencher, Using a Multitouch Book to Enhance the Student Experience in Organic Chemistry, *Journal of Chemical Education*, 96(3): pp. 586-592, 2019.
- [16]. H. Turgut, Prospective Science Teachers' Conceptualizations About Project Based Learning, *International Journal of Instruction*, 1(2), pp. 61-79, 2008.
- [17]. Husamah, Perspective of New Students of Biology Education Department Through Blended Project Based Learning Model, *Jurnal Pendidikan IPA Indonesia*, 4(2): pp.110-119, 2015.
- [18]. Afriana, Permanasari, and Fitriani, Project Based Learning Integrated To Stem To Enhance Elementary School's Students Scientific Literacy, *Jurnal Pendidikan IPA Indonesia*, 5(2): pp. 261-267, 2016.
- [19]. Probosari, Improvement Of Students' Scientific Writing Of Biology Education Of Sebelas Maret University Through Reading Project Based Learning, *Jurnal Pendidikan IPA Indonesia*, 4(1): pp. 31-35, 2015.
- [20]. N. C. Ekowati, T.T. Handayani, E. Rosa, and Sumardi, Uji Aktifitas Enzim Sederhana Untuk Pengakayaan Materi Praktikum Biologi Bagi Guru SMA di Kabupaten Pesawaran, *Makalah Pengabdian Enzim, Jurusan Biologi Universitas Lampung*, 2018.
- [21]. Sugiyono, *Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, dan R&D)*. Bandung: Alfabeta, 2008.
- [22]. E.A. Dalimunthe, S. Silaban, Z. Muchtar, Discovery Learning Based E-module on Protein Material Development, *Proceeding of The 4<sup>th</sup> Annual International Seminar on Transformative Eduacation and Educational Leadership*, Vol. 384, Atlantis Press, 2019. DOI: 10.2991/aisteel-19.2019.137.
- [23]. A. Zulkarnain, N. Kadaritna, and L. Tania, Pengembangan E-Modul Teori Atom Mekanika Kuantum Berbasis Web Dengan Pendekatan Saintifik, *Jurnal Pendidikan dan Pembelajaran Kimia*, 1(4): pp. 222-235, 2015.
- [24]. N. Harefa, and N. Silalahi, Improvement of Student's Learning Outcomes and Motivation With Chemical Practicum E-module, *Jurnal Pendidikan Kimia*, 12(1): 10-19, 2020.