



## Development of E-Module Concerning The Effect of Solid Lipid Nanoparticle on Blood Glucose *Mus musculus* to Improve Students' Critical Thinking Skills



Rofiq Asri<sup>1,\*</sup>, Agus Sundaryono<sup>2</sup>, Rendy Wikrama Wardana<sup>2</sup>

<sup>1</sup> Graduated from School of Science Education, University of Bengkulu, Indonesia

<sup>2</sup> Postgraduate Lecturers in Science Education, Bengkulu University, Indonesia

\*Email: asrirofika@gmail.com

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### ABSTRACT

This study aims to develop an electronic module of teaching material supplements on the effect of solid lipid nanoparticle kebiul extract on blood glucose of *Mus musculus* to improve critical thinking skills of undergraduate students of Chemistry Education, Faculty of Teacher Training and Education University of Bengkulu. This type of research is Research and Development (R&D) based on the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The research was conducted by analyzing student needs for the development of e-module teaching material supplements and continued at the validation stage. The result of the validation of the 3D PageFlip Professional e-module was 89.78% in the very suitable category for use as a teaching material supplement. The validation of the test instrument for critical thinking was 88% with a very valid category and could be tested on students. The N-Gain result data was 0.68 in the medium category, so that the e-module developed is able to improve students' critical thinking skills. The result of the assessment on the student response questionnaire has a score of 89.8% with a very good category and can be disseminated online.

**Keywords:** E-modul, 3D PageFlip Professional application, ADDIE, critical thinking skills.

### INTRODUCTION

The branch of chemistry that discusses the use of medicinal plants is Chemistry of Organic Natural Products. That is a special elective course for Undergraduate Chemistry Education students, Faculty of Teacher Training and Education University of Bengkulu which has 2 theoretical credits. Hakim (2014) stated that the target in Chemistry of Organic Natural Products learning is the students have competence in mastering the concept of organic chemistry of natural materials by knowing the components of primary and secondary metabolite compounds in plants and understanding the basic techniques of chemistry of organic natural products laboratories.

The demands of 21<sup>st</sup> century learning in the 4.0 industrial revolution, innovative learning resources are needed by optimally utilizing technology to improve students' critical thinking skills in learning (Cahyani, 2019). The skills to think logically, reflectively, productively, and systematically that are applied in making good judgment and decision making are a general understanding of critical thinking skills (Zakiah, 2019).

Students need innovative learning resources that can be used anywhere and anytime, such as using modules. In this era, the learning module is no longer a print module. The modules that are being developed for this time are electronic modules or commonly known as e-modules (Seruni, 2019). The advantage of teaching materials using e-modules is the electronic media can make the learning process more interesting, interactive, so that it can improve the quality of student learning.

The development e-module has two functions, namely as a student independent learning tool at home and can be used by lecturers as a tool or addition to teaching in class (Puspitasari, 2019).

The e-module was designed to cover Chemistry of Organic Natural Products learning as a supplement to student teaching materials. Teaching material supplements are print-based or online learning resources that are used to complement the main textbooks in the learning process. The goal is to enrich the readers' insight, experience and knowledge (Jambak, 2019). The e-module supplement for teaching materials that was developed contains the use of medicinal plants and their application in the Chemistry of Organic Natural Products laboratory research. One of the ways to use medicinal plants is Kebiul seed (*Caesalpinia bonduc L.*) which was modified into solid fat nanoparticles to reduce the mice's blood glucose.

The applications that can be used to create e-modules include Exelearning, Kvisoft Flipbook Marker, 3D PageFlip Professional, and Flip PDF Professional (Seruni, 2019). Various e-module maker applications, 3D PageFlip Professional have the advantage that this application is not fixated on just writing but can include motion animation, video, and audio that can make an interactive learning media that is attractive so that learning is not monotonous (Maryam, 2019). The e-module supplement for teaching materials using 3D PageFlip Professional which will be developed in the Chemistry of Organic Natural Products learning process is expected to be able to improve students' critical thinking skills.

## RESEARCH METHODS

This type of research is Research and Development (R&D) using the ADDIE model (Analyze, Design, Development, Implementation, and Evaluation) (Andriani, 2019). The research subjects were 30 undergraduate students of Chemical Education Faculty of Teacher Training and Education University of Bengkulu. The research and development site was carried out at the University of Bengkulu, Indonesia. Instruments for collecting research data and developing teaching material supplements, namely the test questions and response questionnaires. The summary of the stages in the ADDIE model used is as follows:

### 1. Analysis Phase

This stage began with conducting laboratory research as e-module primary data. Analysis of e-module needs for teaching material supplements by distributing the Chemistry of Organic Natural Products e-module needs questionnaire. The stages of the analysis carried out by the author include three things, namely needs analysis, curriculum analysis, and character analysis of students.

### 2. Design Stage

The design of the instrument used was an instrument of critical thinking skills based on the indicator aspect according to Ennis (2011). Make e-module drafts and student response questionnaires.

### 3. Development Stage

The development stage was validating the e-module supplements for Chemistry of Organic Natural Products teaching materials and validating essay questions for critical thinking skills by a team of experts. Test the questions on a small scale of students to find out the validity, reliability, distinguishing power, and the difficulty level of the questions.

### 4. Implementation Stage

Preparing learning that involved students by distributing e-module supplementary teaching materials to the students, testing e-module teaching material supplements, and implementing pretest and posttest about critical thinking skills.

### 5. Evaluation Phase

Distributing response questionnaires to the students after using the e-module natural ingredients supplements as the last revision in the study.

## RESULTS AND DISCUSSION

The data obtained in this study were to improve critical thinking skills through e-module supplements for Chemistry of Organic Natural Products teaching materials for undergraduate students of Chemistry Education, Faculty of Teacher Training and Education University of Bengkulu, as follows:

### 1. Analysis Phase

The primary data obtained was presented in the e-module of teaching material supplements to be developed. The e-module needs questionnaire that was distributed to students using the Guttman scale, got a percentage value of 89.7%. These results state that there was a need for an innovation in Chemistry of Organic Natural Products teaching materials so that students would be able to create critical thinking in learning.

### 2. Design Stage

The design started with the creation of a 3D Pageflip Professional-based e-module, an instrument for essay questions (pretest and posttest) in accordance with the critical thinking aspects being tested and to make a question assessment rubric. Student response questionnaires were made to assess display aspects, material presentation aspects, and benefit aspects of using the e-module supplements for Chemistry of Organic Natural Products teaching materials.

### 3. Development Stage

The results of the data validation carried out included validation of e-modules and validation of essay questions for critical thinking skills by a team of experts. On the Table 1. After carrying out various stages of revision, it can be seen that the average percentage of the validation results is 89.78% with the very appropriate category to be used as a supplement to Chemistry of Organic Natural Products teaching materials.

Table 1. Percentage of E-Module Validation Results for Chemistry of Organic Natural Products Teaching Materials Supplement

Percentage of Validation Results			Average Percentage	Qualification Category
Material Expert 1	Material Expert 2	Media Expert	Validation result	
92,3%	90,63%	86,4%	89,78%	Really Worthy

On the Table 2. from the item analysis after revision, both the questions and the scoring rubric obtained a percentage of 88% with a very valid category.

Table 2. Analysis of Question Item Validation

Question Item Number	Panelist Validation Results		% Validation	Validity
	P1	P2		
1	4	4	80	Valid
2	4	4	80	Valid
3	4	5	90	Valid
4	5	5	100	Valid
5	5	4	90	Valid

Testing questions on a small scale of students to determine the validity, reliability, distinguishing power, and difficulty level of the questions can be seen in Table 3 below.

Table 3. Results of Validity, Reliability, Distinguishing Power and Level of Difficulty

Average= 10,09; Standard Deviation= 2,95; Correlation XY= 0,62; Reliability Test=0,77

Item Question= 5; Number of Subjects= 11

Question Item Number	Validity	Validity Category	T	Discernment%	Level of Difficulty %	Level of Difficulty Category
1	0,701	Significance	5,00	55,56	72.22	Easy
2	0,670	Significance	1,41	22,22	66.67	Moderate
3	0,744	Very Significance	4,00	44,44	55.56	Moderate
4	0,859	Very Significance	5,00	55,56	72.22	Easy
5	0,686	Significance	2,83	44,44	66.67	Moderate

The table above shows that the items 1 to 5 are declared valid, so they can be used for pretest and posttest assessments to see students' critical thinking skills.

#### 4. Implementation Stage

The implementation stage included giving pretest questions as a preliminary test to determine the level of critical thinking of students. Distribution of e-module teaching material supplements through the .HTML or .exe link and conducted the final test (posttest). The results of using the e-module supplements for Chemistry of Organic Natural Products teaching materials in Table 4. had an average N-Gain value of 0.68% in the moderate category and could improve students' critical thinking skills.

Table 4. Indicators of Students' Critical Thinking Skills

Dimensions	Score		difference	N-Gain	N-Gain Category	Score Criteria
	Pretest	Posttest				
Focus on the questions	23,2	75,6	52,4	0,68	Medium	Critical
Consider whether the source is trustworthy / not	38,9	85,6	46,7	0,74	High	Critical
Summing up by inducing and considering	35,6	73,3	37,7	0,58	Medium	Critical
Identify assumptions	38,9	84,4	45,5	0,74	High	Critical
Take decisions into action	25,6	72,2	46,6	0,62	Medium	Critical
<b>Average</b>	<b>32,4</b>	<b>78,2</b>	<b>45,8</b>	<b>0,68</b>	<b>Medium</b>	Critical

According to Warda (2018), the N-gain test is used to determine an increase in critical thinking skills in students after being given pretest and posttest questions. The graph of increasing critical thinking skills based on the results of the pretest, posttest and N-Gain can be seen in Figure 1.

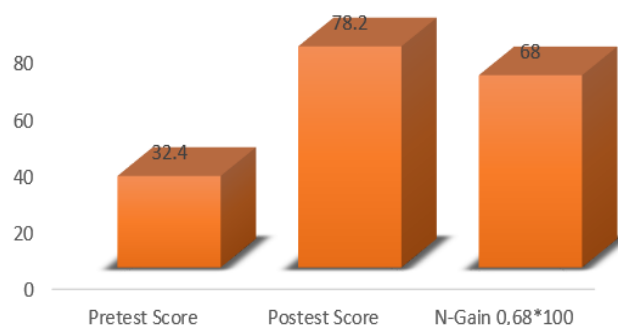


Figure 1. Graph of Critical Thinking Skills at Pretest, Posttest and N-Gain

#### 5. Evaluation Phase

The final revision stage of the developed Chemistry of Organic Natural Products teaching material supplement e-module. This is for the e-module development was truly ready to be disseminated online. The results of the assessment on the student response questionnaire had a score of 89.8% in the very good category. Student response questionnaires were made based on three aspects of assessment, including aspects of appearance, aspects of presentation, and aspects of benefits.

### CONCLUSIONS

The results showed that the e-module teaching material supplements met the validation criteria of 89.78% with a very feasible category. The validation of questions by the expert team was 88% with the very valid category to be used as a test instrument. The small scale test of the instrument obtained valid data, so it could be used as a student's pre-test and post-test. The N-Gain result data was 0.68 in the moderate category, indicating that the e-module developed was able to improve students' critical thinking skills. The results of the assessment on the student response questionnaire had a score of 89.8% with a very good category and can be disseminated online.

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