

Development of E-Module on The Diversity of Living Things on Problem-Based-Learning (PBL) to Improve Students' Critical Thinking Skills

Ainun Cornelia Verdamil¹, Fatchur Rohman², Hendra Susanto³, Wijiasih⁴
Fikri Syahir Robi⁵

¹Masters Program of Biology Education, Universitas Negeri Malang, Indonesia

^{2,3}Departement of Biology, Universitas Negeri Malang, Indonesia

^{4,5}MAN Kota Batu School, Indonesia

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ABSTRACT

An ineffective learning process can cause students' critical thinking skills to be low. This study aims to develop an e-module for the diversity of living things based on problem-based-learning (PBL) in improving students' critical thinking skills. Research and development model from Lee & Owen (assessment/analysis, development design, implementation, and evaluation). This research was conducted at MAN Kota Batu. The research population, namely all of tenth grade students in the school year of 2023, the sample used was 36 students with sampling techniques using non-probability by purposive sampling. The research design was one-group-pre test-post test to measure the critical thinking skills after using the e-module. Based on the results showed that the e-module developed was stated very valid (97, 25%), very practical based on students' responses (91, 6%) and teachers' responses (89%), and based on the N-gain score to see the effectiveness obtained a value of .6 which means that the students' critical thinking skills developed in the medium category after the application of e-module based on Problem-based-learning.

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Corresponding Author:

Ainun Cornelia Verdamil,

Masters Program of Biology Education, State University of Malang

Jalan Semarang No.5, Sumbersari, Kec. Lowokwaru, Kota Malang 65145, Indonesia

Email: ainuncornelia61@gmail.com

1. INTRODUCTION

Education has an important role in facing the era society 5.0 in creating quality human resources (Kahar et al., 2021). In this era, it is required to have knowledge and technology in the development of students who will form quality human resources in the future. Therefore, students are expected to have skills that need to be possessed. These skills include creative thinking, critical thinking and problem solving, communication, and collaboration skills (Tamin et al., 2022).

Critical thinking skills are very important for students to develop. However, the facts in the field indicate that not all students can develop critical thinking skills, which causes students' critical thinking skills in Indonesia to be low (Satwika et al., 2018). The research of Hidayati et al., (2021) stated that students' critical thinking skills obtained an average score of 40.62 (low). Khoirunnisa & Sabekti (2020) obtained a critical thinking skills score that was classified as low with an average achievement of 34.45 as much as 36.84% of 190 students. Students' inadequate critical thinking skills may be caused by ineffective learning processes that do not support their interests, talents, and potential (Anisa et al., 2021), or by students' poor reading habits (Muttaqin & Sopandi, 2015).

Based on the results of the needs analysis at MAN Kota Batu obtained from student questionnaires on critical thinking skills, the average percentage value is 73.64%. The lowest percentage acquisition was shown in the analyzing indicator of 71.3%. One of the obstacles in the learning process is the availability of critical thinking skills, media and teaching materials so that this will affect the learning process. Media and teaching materials that are often used by biology teachers at MAN Kota Batu on the diversity of living things are in the form of power-points and videos but have not been integrated into critical thinking skills. So, teaching materials are needed that can empower critical thinking skills. This is reinforced by the statement of the biology teacher of MAN Kota Batu that they do not have media and teaching materials yet in the form of e-modules. Therefore, researchers developed an e-module to assist in the learning process.

According to Suarsana & Mahayukti (2013) e-module has a more interactive nature that makes it easier to navigate, and there is quiz that allows automatic feedback immediately. Learning model is needed to achieve the achievement of learning objectives in the application of e-module in the learning process. PBL is one of the learning models that can be used. PBL is one of the learning strategies suitable for fostering 21st century skills (Kartini et al., 2022). Learning that fosters 21st century skills is more effective than conventional learning (Fitriani et al., 2020). The learning process by presenting problems can motivate students in critical thinking skills through the problem-solving process (Saputra et al., 2019). Damage to the habitat of living things is one of the most common surrounding problems because it can push species and even entire communities to the brink of extinction (Wahyuni & Zakaria, 2018). Therefore, the diversity of living things is one of the Learning Outcomes (CP) that must be learned to students, which has been stated in the Merdeka Curriculum phase E (Kemendikbudristek, 2022). PBL activities involve students thinking about solutions from simple, challenging problems to very complex problems (Kardoyo et al., 2020).

E-module based on PBL becomes learning that challenges students to learn, increase curiosity, and analytical skills in finding solutions to problems by discussing with groups. Prabasari et al., (2021) revealed that students' critical thinking skills improved by using an e-module based on a problem-based learning model or orienting students to a problem that helps students to build scientifically correct knowledge or concepts. However, the results of research (Priyadi et al., 2018) show that the students' critical thinking skills are low due to the selection of a learning model that has not been able to train students' critical thinking skills. Therefore, there is a need for an e-module in which there are stages of Problem Based Learning (PBL) that can improve critical thinking skills. The purpose of this study is to develop an e-module on the diversity of living things based on Problem Based Learning (PBL) to improve students' critical thinking skills.

2. RESEARCH METHOD

This research was conducted at MAN Kota Batu. The time of this research was carried out in August-September 2023 which was adjusted to the material of the diversity of living things in the school year of 2023/2024. Then the research population, namely all of tenth grade students in the 2023 school year, the research sample amounted to 36 students with sampling techniques using non-probability by purposive sampling. This research design is one-group-pretest-posttest to measure critical thinking skills after the use of e-module.

This study uses the research and development model from Lee & Owen, namely 1) assessment and analysis, 2) design, 3) development, 4) implementation, and 5) evaluation. This model was chosen because it has a well-organized and clear structure at each stage of developing multimedia products. The instrument used is a questionnaire sheet for validation of material experts, media and teaching material experts and biology education practitioners. The critical thinking skills test sheet uses assessment guidelines adapted from Greestein (2012).

Qualitative data was obtained from suggestions and comments given by validators and students. Quantitative data was obtained based on the assessment by validators and students on the questionnaire given. While the critical thinking skills test data were analyzed using the N-gain score adapted from Hake (1999). The N-gain score results were interpreted based on the categories presented in Table 1

Table 1. N-gain Interpretation

Range	Category
$0,70 \leq g \leq 1,00$	High
$0,30 \leq g < 0,70$	Medium
$0,00 < g < 0,3$	Low

3. RESULT AND DISCUSSION

A. Validity of E-Module

The acquisition of an average value of 97.25% which is classified as very valid is the result of e-module validation conducted by material expert validators, media and teaching material experts, and biology education practitioner experts by obtaining an average value of 97.25% which is classified as very valid. The validation scores are listed in Table 2.

Table 2. Summary of Validation Results by Validators

Validator	Value (%)	Category
Material Expert	100	Very Valid
Media and Teaching Material Expert	100	Very Valid
Biology Education Practitioner	91,75	Very Valid
Average	97,25	Very Valid

Based on the table above, this shows that the e-module developed is in accordance with the needs and characteristics of the e-module and it is suitable for use in learning activities. The suggestions and comments were given by the validators as improvement material so that the e-module can function optimally in learning activities. The suggestions and comments given are as follows:

"Author's writing on species names must be upright, correcting sentences that are not standardized or changing sentence patterns, image identity is completed, consistent in writing Problem-Based Learning"; "Sentences in instructions use command sentences, practice questions should refer to all indicators"; "Material in the e-module should be added regarding the diversity of living things in Indonesia and the classification of living things".

The results of the review and improvement by experts were then tested on students. The e-module trial was carried out with 3 stages, namely individual trials, small group trials conducted on 6 students, and field trials conducted on 34 students. The results showed that the e-module developed was categorized as very valid with a score of 91.6%. The results of the trials that have been carried out are listed in table 3.

Table 3. Summary of E-Module Trial Results

Trial Type	Value (%)	Category
Individual	92,1	Vey Valid
Small Group	90,3	Very Valid
Field	93,5	Very Valid
Average	91,6	Very Valid

B. Practicality E-Module

The results of the practicality assessment of e-module based on Problem Based Learning were conducted by biology teachers of MAN Kota Batu and students with a total of 36 respondents. The results of the practicality assessment are presented in table 4.

Table 4. Results of E-Module Practicality Assessment

No	Characteristics of E-modules based on PBL	Percentage			
		Teacher	Category	Student	Category
1	Attractiveness of e-module	100	Very Practical	98,2	Very Practical
2	Ease of e-module to use	86,6	Very Practical	89,6	Very Practical
3	Ease of understanding the material e-module	96	Very Practical	95,7	Very Practical
4	The up to date of E-module resources	80	Very Practical	88,5	Very Practical
5	Language	90	Very Practical	85,8	Very Practical
6	Able to train critical thinking skills	100	Very Practical	93,3	Very Practical
7	Able to train collaboration skills	100	Very Practical	91,6	Very Practical
8	Able to train environmental attitudes	80	Simply Practical	94,4	Very Practical
Average Score (%)		91,5	Very Practical	92,1	Very Practical

Based on the table above, the results of the practicality of the biology teacher MAN Kota Batu that the e-module of the diversity of living things based on Problem Based Learning developed is very practical with a score of 91.5% on the results of student practicality show that the e-module developed is very practical with a score of 92.1%. There are some suggestions and input given by students. The suggestions and input given are as follows:

"This *e-module* makes me more interested in learning because it is accompanied by pictures; this *e-module* makes it easier to learn which is accompanied by articles or materials and questions related to the material; the use of *e-module* makes learning more effective; *e-module* and materials are very easy to understand and interesting so that I am motivated to learn; the appearance and color of *e-modules* are attractive, easy to see and not boring".

C. Effectiveness of E-Module

The effectiveness of e-module can be seen through the increase in the value of critical thinking skills that can be measured using pre-test and post-test questions whose assessment is guided by the critical thinking skills assessment rubric from Greestein (2012) after implementing e-module in the learning process. The N-gain score is presented in Table 4.

Critical Thinking Skills	\bar{x} Pretest	\bar{x} Posttest	\bar{x} N-gain	Category
	53,75	83,75	0,6	Medium

Based on Table 4 e-module diversity of living things based on PBL can improve students' critical thinking skills in terms of the N-gain score of 0.6 which is categorized as medium. The results of the analysis showed that students experienced an increase in each indicator of critical thinking skills after implementing the e-module in learning. The indicator that experienced the highest increase was the evaluation indicator of 96%. The increase in each indicator of students' critical thinking skills is presented in Figure 1.

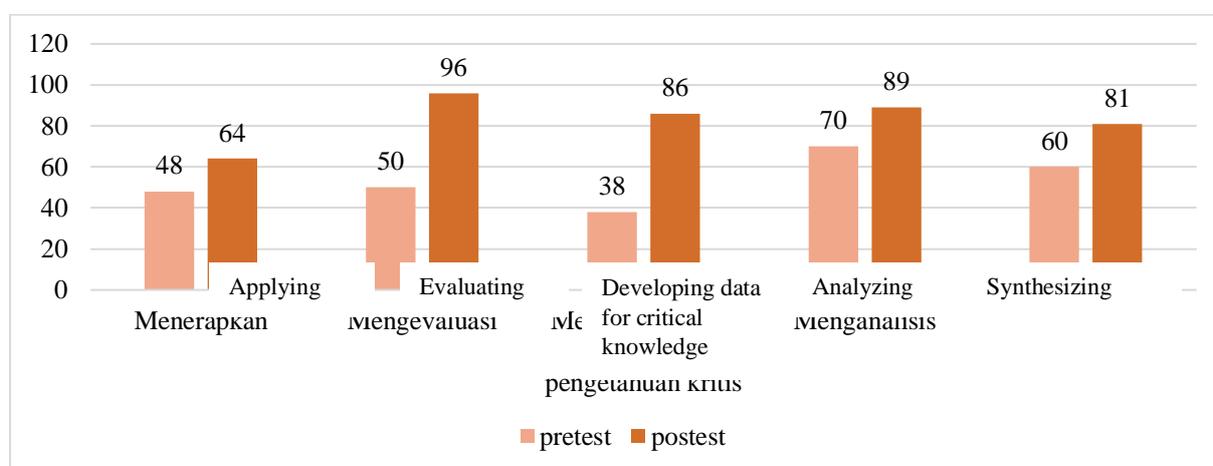


Figure 1. Pre-test and Post-test Results of Each Critical Thinking Skills Indicator

The pretest results show that most students have low scores in each indicator of critical thinking skills before the use of e-modules based on PBL in learning. Students' posttest results have increased in each indicator of critical thinking skills after the implementation of e-module based on PBL. In the indicator of applying student knowledge increased by 16%, the indicator of evaluating increased by 46%, the indicator of developing data for critical knowledge increased by 48%, the indicator of analyzing increased by 19%, and the indicator of synthesizing increased by 21%. This is reinforced by the N-gain score (Table 4.) which shows that learning using e-module diversity of living things based on Problem Based Learning is effective in improving critical thinking skills because in the learning process students are required to develop their knowledge by finding solutions to the contextual problems presented. This is in line with the statement of Aufa et al., (2021) that the use of e-modules with reference to the PBL learning model can have a positive effect on critical thinking skills.

The PBL learning model directs learning that is active, innovative, creative, creates a fun, meaningful and productive atmosphere so that the learning process is student- centered (Komariyatin & Dimas, 2022). Students can develop their knowledge and improve their ability to analyze problems through the PBL learning model. In addition, students are expected to have a confident, persistent, and flexible attitude in thinking to explore their ideas (Sitanggang & Amry, 2022).

Every PBL activity is able to empower critical thinking skills. At the problem orientation stage, students are trained to analyze. Students identify problems and understand complex ideas that exist in the problem by finding and using relevant sources. The development of critical thinking involves the skills of analyzing text, data and arguments (Roviati & Widodo, 2019).

At the stage of organizing students and independent and group investigations can train students on indicators of applying, developing data for critical knowledge, analyzing, and synthesizing. Students are grouped to conduct discussions with group members. Students search for information and accurately select data from various sources and real experiences, compile ideas and compare arguments in order to produce a summary to provide a solution to solving the problem. this problem-solving process will motivate students to conduct deeper investigations, so that it can create knowledge independently and questions will arise that will train students' thinking skills (Maulidya et al., 2021).

Furthermore, the stage of developing and presenting results of the work. After finding a solution to the problem, it is then developed in the form of work and presented in front of the class. Making work in groups will train critical thinking skills because they are required to have ideas or ideas to find solutions to problems, so students will try to think at a high level (Herzon et al., 2018). Then at the stage of analyzing and evaluating the problem-solving process trains students on the evaluation indicator. The evaluation submitted relates to several opinions, responses, suggestions, and questions from the teacher and other groups to determine the best solution in problem solving. This evaluation stage is the final step of making decisions in solving problems independently, so that the process can improve students' critical thinking skills (Herzon et al., 2018)

All stages of PBL provide students' experiences in solving complex problems in real life through analyzing a problem, investigating, developing work and making conclusions related to problem solving. This trains students' thinking skills and students will gain new knowledge. This model causes students' motivation and curiosity to increase (Garjita et al., 2017). Increased motivation and curiosity will involve students being active so that the learning process will become more meaningful (Supiandi & Julung, 2016).

4. CONCLUSION

Based on the acquisition of the N-gain score of 0.6 which is categorized as medium, it can be concluded that the e-module of the diversity of living things based on Problem Based learning can improve students' critical thinking skills. Therefore, this e-module based on Problem Based learning can be used to improve students' critical thinking skills in the learning process.

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