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Developing of Electronic Module on Problem-Based Learning (Pbl) to Improve Creative Thinking Skills

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ABSTRACT
Creative thinking skills can be empowered to students during the learning process using appropriate learning materials. The study aimed to develop electronic module on problem-based learning that is valid, practical and effective to improve students' creative thinking skills. This development follows the model of Lee & Owens (Assessment/ analysis; Design; Development; Implementation; and Evaluation). The validity was determined based on expert assessment (media, material, educational practitioners) and practicality was evaluated based on field practitioners and students' responses which were analyzed descriptive quantitative percentages. Meanwhile, the effectiveness data were collected through open questions to assess the improve in creative thinking skills based on the rubric of creative thinking skills and analyzed using the N-gain score. The results showed that the developed electronic module on problem-based learning was declared as very valid (98.6%), very practical based on practitioners' responses (93.55%) students' responses (95.92%), and effective for improving creative thinking skills (0,35). Hence, it can be concluded that electronic module on problem-based learning can be used to improve students' creative thinking skills.

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1. INTRODUCTION

Education is an important factor to improve the quality of an individual. Therefore, there is a need for innovation by reforming the curriculum. In Indonesia, the Independent Curriculum has been implemented for the learning process due to the post-Covid-19. Based on the Decree of the Minister of Education and Culture No. 262/M/2022, the Independent Curriculum was developed to include (1) learning and assessment, (2) learning outcomes, (3) soft skills and character development through projects to strengthen Pancasila student profiles, (4) focus on essential, relevant, and in-depth material, (5) as well as flexible learning. The Independent curriculum was developed by integrating 21st-century skills which include the 4C, namely Critical thinking and problem solving; Creativity and innovation; Communications and Collaboration (Rochmawati *et al.*, 2020; Triana *et al.*, 2020. The purpose of which is that students can be globally competent and able to face the demands of life as hi-tech professionals (Asrizal *et al.*, 2022).

The Partnership for 21st Century Skills (P21) reveals that one of the important skills to be empowered is creative thinking skills. Creative thinking skills are defined as the ability to see problems from various perspectives and produce different solutions (Rochmawati *et al.*, 2020; Supena *et al.*, 2021). The output of creative thinking is a product of creativity as external evidence of the occurrence of a creative thinking process, which is a dynamic thinking process between divergent and convergent thinking. Creative thinking skills have four aspects, namely *fluency, flexibility, originality, and elaboration* (Treffinger *et al.*, 2002). Creative thinking skills are closely related to the learning process. It is because they are needed for current and future educational conditions. Hence, optimizing creative thinking skills are important because students can practice to produce new ideas in solving problems in everyday life and will have a positive impact on students readiness to face increasingly complex problems in the 21st century (Wilis *et al.*, 2023).

Creative thinking skills are relevant to Biology learning because they relate to real life events (Asrizal *et al.*, 2022). The learning process that integrates problems can increase student creativity through the process of

identifying problems to find solutions by utilizing their knowledge and skills. Therefore, that they can produce new, unique and creative ideas in solving problems (Rahardjanto *et al.*, 2019; Yustina *et al.*, 2020) because students are able to explain the causal relationship of the problems that occur (Shukri *et al.*, 2020). In accordance with the objectives of the Independent Curriculum on Biology learning outcomes for class 10 in phase E, students are required to have the ability to be responsive to global issues and play an active role in solving problems by applying material that is oriented towards crucial problems in life, aiming to achieve sustainable development through creative skills in creating new problem solving ideas, so as to train students to analyse problems and find solutions from various sources of information to generate new ideas relevant to the problem (BSAKP, 2022). The results of the preliminary study show that the level of students' creative thinking skills is low with an average value of 39.68% relevant to the preliminary study of other research (Gunawan *et al.*, 2017; Khoiriyah & Husamah, 2018), and reinforced by the results of the analysis of Reche & Perfectti (2020), that the low value of skills creative thinking shows that creativity has not developed optimally. This is because creative thinking skills are rarely the goal of learning. In addition, it is also influenced by learning environment factors, learning resources, and ineffective learning methods (Sandika & Fitrihidajati, 2018).

Based on the results of the preliminary study, students at MAN Sumenep use teaching materials in the form of textbooks, and 85.19% of the 27 student respondents still need other independent teaching materials to support learning in order to increase their knowledge. Therefore, it needs to be supported by learning media that can help students understand the concept of environmental problems, namely electronic modules as an alternative to independent teaching materials supported by a multimedia-based learning process (Muliyati *et al.*, 2018). Electronic modules also play a role in assisting educators in explaining material (Pramana *et al.*, 2020) because the preparation of electronic modules aims to meet needs and assist students in achieving learning goals and desired competencies (Amrulloh *et al.*, 2020). Hence, the learning activities carried out by students in the electronic module can run like real activities. One learning model that is in accordance with the Independent Curriculum is problem-based learning.

Problem-based learning can encourage students to be active in the process of creative thinking to solve systematic problems and study various real problems through discussion and investigation activities because complex problems cannot be solved with only one solution and are open ended (Alifiani *et al.*, 2019). The advantages of problem-based learning are that at each stage it is able to develop students' creative thinking skills, because the learning process presents contextual problems and becomes the main focus of learning which starts with organizing students on a problem. Research by Khoiriyah & Husamah (2018) and Handayani & Koeswanti (2021), revealed that the application of the problem-based learning model can increase student creativity. The reason is because learning that integrates authentic problems can train creative thinking skills. Therefore, students are able to explore in finding various problem-solving information through the process of investigation and changing students' mindsets to be more objective (Alifiani *et al.*, 2019).

The problem-based learning process should be an alternative solution to implementing the Independent Curriculum because the learning concept is oriented towards student-centered and real problems. In addition, learning strategies in the Independent Curriculum should provide learning experiences that are carried out by integrating information technology tools and communication. Based on the facts described, this study aims to develop electronic module on problem-based learning to train students' creative thinking skills.

2. RESEARCH METHOD

Product development follows the model of Lee & Owens (2004) (Assessment/ analysis; Design; Development; Implementation; and Evaluation). The research was carried out at MAN Sumenep from January to March 2023 with 32 respondents from class X. The instrument used was a validation questionnaire sheet from three experts (media expert, material expert and education practitioner); practicality questionnaire obtained from field practitioners and students; as well as a test sheet for creative thinking skills using the scoring guidelines adapted from Treffinger *et al.*, (2002). Validity and practicality data were analyzed using descriptive quantitative percentages, while creative thinking skills test data were analyzed using the N-gain score and criteria adapted from Hake (1999) it was presented in Table 1.

Table 1. Interpretation of N-gain

N-gain	Criteria
$0{,}70 \leq g \leq 1{,}00$	High
$0{,}30 \leq g < 0{,}70$	Medium
$0{,}00 < g < 0{,}30$	Low

3. RESULT AND DISCUSSION

a. Validity of Electronic Module

The validity results of the electronic module by three validators show that the electronic module is considered as valid category with a mean percentage of all aspects of 98.6%. Validation results of aspect, percentage and category are presented in **Table 2**. In addition, there are also suggestions and comments from the validator as follows.

"*In general, it is good, very interesting, and in accordance with technological developments and the essence of the curriculum*"; "*There are so many photos that can be uploaded on the impact of water and air pollution; preferably from the cases that occurred in Indonesia*"; "*Electronic module is something new that students know, because so far students are used to using modules in paper form. In general, the use of electronic modules is very interesting because students can connect to appropriate materials and can add to their insights. Its appearance is attractive and full color is not boring and can provoke curiosity*".

Table 2. Validation results of aspect, percentage, and category

Point	Aspect	Percentage			Mean of all Percentage	Category
		V1	V2	V3		
A	Content	100%	98,7%	98%	98,9%	Very valid
B	Learning materials	100%	100%	92,5%	97,5%	Very valid
C	Presentation	100%	99%	100%	99,7%	Very valid
D	Language	100%	100%	95%	98,3%	Very valid
	Mean of all aspects				**98,6%**	**Very valid**

Note: 1) media expert; 2) material expert; 3) education practitioner

Based on the validation results of the developed electronic module on problem-based learning, it was categorized as very valid with a total percentage of 98.6% (Table 2). This shows that the developed electronic module on problem-based learning is in accordance with the needs and characteristics of the electronic module and is suitable for use in learning. Point A (Table 2) explains that the electronic module fulfills the characteristics that can be used for independent learning because there are clear learning objectives and instructions for using the electronic module; point B (Table 2) explains that electronic module is able to facilitate students to improve their academic abilities because the material presented is appropriate, making it easier for students to understand the material. Point C (Table 2) shows that the electronic module is interesting to use. It meets the criteria for display quality both images and video, layout, design and color quality, text accuracy, and clear time allocation in accordance with the characteristics of the electronic module preparation. Although the electronic module is in the very valid category in terms of presentation, there are comments from teaching material media experts suggesting that pictures related to water and air pollution be added on a national scale. Point D (Table 2) explains that the sentences and terms used are in accordance with PUEBI provisions and according to the level of students' intellectual development, so that the information conveyed in the electronic module will be easily understood by students. This affects students' understanding of material and can motivate students to learn. Based on the suggestions given by the validator, the developed electronic module on problem-based learning is revised and improved, so that the electronic module on problem-based learning can function optimally.

b. Practicality of Electronic Module

The electronic module which has been reviewed by the three experts, is then assessed as a whole by field practitioners, the biology teacher at MAN Sumenep. The results of the practicality assessment of the electronic module show that the electronic module on problem-based learning is very practical with an average percentage of all aspects of 93,55%. Then, the results of student responses obtained from 32 respondents, in general students gave positive responses to the electronic module. This is shown by the average total percentage of positive responses which reached 95.92%, that the developed electronic module on problem-based learning is very practical. Practical results of aspect and percentage are presented in Table 3. In addition, there are also suggestions and comments from field practitioners as follows.

"*The use of electronic modules in learning can be practical teaching materials because they are easy to use. Presentation of material and learning activities in providing new knowledge for students and the learning process in the classroom becomes active*"

Comments and suggestions were also given by students on the electronic module as follows.

"*It's good, but if it's difficult and take a long time to move to the next slide and have to wait for it to come out, it's fun to find a solution*"; "*If possible, the electronic module can be used as an application that can be downloaded for free and fixes bugs that often appear*"; "*The electronic module can be*

used offline and can be downloaded too. Electronic module can help online learning at this time"; "*Electronic module learning is easy to understand*"; "*Very good electronic module*"

Table 3. Practical results of aspect and percentage

Point	Aspect	Percentage			
		Educational Practitioners	**Category**	**Students'**	**Category**
A	Attractiveness	100%	Very practical	98,13%	Very practical
B	Ease to use	97%	Very practical	96%	Very practical
C	Ease to understanding	94,55%	Very practical	95,97%	Very practical
D	Creative thinking skills	79,79%	Practical	94,84%	Very practical
E	Reference resource	90%	Very practical	93,13%	Very practical
F	Language	100%	Very practical	97,50%	Very practical
	Mean of all aspects	**93,55%**	**Very practical**	**95,92%**	**Very practical**

The results of the field practitioner's stated that the developed electronic module on problem-based learning was very practical, attractive and had a good design (Table 3), thus triggering students to be active because it is student-centered learning and trains students' creative thinking skills. This is because the product development process is carried out by analyzing the gaps that occur in the field covering five aspects, namely (1) needs analysis; (2) critical incident analysis; (3) assignment analysis; (4) analysis of learning objectives based on the curriculum; and (5) continued with revisions and improvements. This is important in a gradual and continuous development process, because it will produce a quality product.

The students' response to point A (Table 3) was 98.18%, point B (Table 3) was 96%, and point C (Table 3) was 95.97% in the very practical category. This explains that the design and features of the electronic module and the contextual problems presented can attract students' interest in learning. The appropriate combination of colors and images allows students to easily understand the material being studied, thus helping students to concentrate on carrying out the learning process in a fun way. Point E (Table 3) obtains a total average of 97.50% in the very practical category because the sentences and terms used are easily understood by students. This is because the use of language is adjusted to the level of students' thinking, making it easier for them to understand the material (Ikalindhari *et al.*, 2020).

c. Effectiveness of Electronic Module

The effectiveness of the electronic module is proven by increasing the score of creative thinking skills after learning to use electronic modules on problem-based learning with the N-gain score test from the pretest and posttest scores. The results of the N-gain score analysis obtained a value of 0.35 (Table 4) indicating the effectiveness of the electronic module is in the moderate category.

Table 4. N-gain Score

	Mean *Pretest*	**Mean *Posttest***	***N-gain Score***
Creative thinking skills	50,78	71,67	0.35

Students gave a positive response to the electronic module at point D (Table 3), explaining that the electronic module meets the indicators of creative thinking skills. This shows that the developed electronic module can train students' creative thinking skills and fulfill all indicators of creative thinking skills in determining solutions to problems by developing the knowledge or information obtained. This is reinforced by the results of the N-gain score (Table 4), indicating that learning using electronic modules on problem-based learning is quite effective and able to empower creative thinking skills, because the learning process is problem-oriented in the student's environment and the information needed in solving problems can be searched through electronic module and can be added from other sources on the internet. In line with the statement of Karenina *et al.* (2020), that mastery of the material and students' understanding will be better by using electronic modules in learning.

Creative thinking skills are needed in Biology learning, because students are expected to be creative and be able to do an innovation to solve all problems that are in their environment, because the creative thinking skills are able to encourage someone to innovate in finding alternative solutions that are new and original to solve people. Students who are trained to explain problem solutions in detail make it possible to carry out in-depth studies of material and problem concepts, integrate theory and practice, and apply different concepts to determine existing problem solutions (Andini & Hobri, 2017). The problem-based learning process aims to find solutions through problem-based learning knowledge carried out by students so that it has an impact on changing education for the better. Therefore, the developed electronic module on problem-based learning is able to support the

improvement of students' creative thinking skills, because it is oriented to problem around their environment and each stage is able to improve students' creative thinking skills. The syntax of the problem-based learning model includes orientation to the problems, organization of students, investigation, explanation, analysis and evaluation (Arends, 2012).

Each stage of problem-based learning is able to empower creative thinking skills. Indicators of creative thinking skills namely fluency and flexibility, can be empowered at the orientation to the problems and organization of students, through identifying real problems that occur around them in news articles presented in groups and building knowledge through summaries regarding basic concepts and problem information from the electronic module and other relevant and credible sources. This adheres to Jerome Bruner's learning theory that learning is an independent learning process with an investigative experience, then David Ausubel's learning theory. namely meaningful learning, means connecting new knowledge with what it already has (Arends, 2012).

The originality indicator is empowered at the investigation stage to find unique solution ideas and is developed at the explanation stage in the form of imaginative work in delivering the given solution. Then analysis and evaluation activities are carried out to determine the suitability of the solutions given to be applied in life by explaining the advantages and disadvantages of the solutions. Both stages adhere to Jean Piaget's constructivist learning theory that the process of growing and developing knowledge is through experience. During the learning process, there are two processes of activity, namely the process of connecting information with knowledge that has been internalized in the brain and the process of combining new experiences that have been received, and changing the structure of knowledge that has been owned with new knowledge (Arends, 2012). The last stage of problem-based learning is analysis and evaluation phase can empower elaboration indicators. This adheres to Lev Vigotsky's learning theory which emphasizes the role of social interaction as a process of cognitive development of a person with the help of others, namely the zone of proximal development, how to solve problems through social interaction with teachers and peers (Arends, 2012).

The results of this study show that the use of electronic module on problem-based learning as teaching materials is more effective for improving creative thinking skills. The ability for creative students to find new ideas is greater by using the electronic module on problem-based learning that has been developed. In addition, the electronic module on problem-based learning is innovative, effective, and efficient learning because it aims to determine solutions through the knowledge gained so that it has an impact on changing the mindset of students for the better. The findings of this study are in line with the research results of Alifiani *et al.* (2019) and Kurniawan *et al.* (2020), that the application of the problem-based learning model can facilitate students to understand concepts correctly and be able to apply the concepts they have learned to find solutions to complex problems.

Optimal creative thinking skills are the basic capital for students to face complex problems in the environment, so that students have an open-minded and critical mind with different perspectives. Relevant to Patmawati *et al.*, (2019) explanation, that a problem-based learning syntax that involves students directly in the problem-solving process will make learning meaningful, allowing students to generate new knowledge. Through practicing creative thinking skills in learning, it is beneficial for students to organize various ideas into different thoughts, make combinations of various existing ideas and then evaluate the results of their thoughts. So mastery of creative thinking skills enables students to be able to face a world that is changing rapidly and to face an uncertain future (Asrizal *et al.*, 2022; Hanif *et al.*, 2019; Wilis *et al.*, 2023).

4. CONCLUSION

Electronic module on problem-based learning very valid (98,6%), very practical (education practitioner 93,55% and students' 95,92%) and effective for improving creative thinking skills (0,35). Therefore, this electronic module on problem-based learning can be used to improve students' creative thinking skills in learning.

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