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The Development of Physics Learning Module Based on Creative Thinking

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Abstract – *The objectives of this study are (i) analyzing the profile of the Physics learning module based on creative thinking; (ii) analyzing the teachers'/practitioners' responses toward the development of Physics learning module based on creative thinking; (iii) finding out the improvement of learning outcomes by using the Physics learning module based on creative thinking. The subject of this study was 30 students of XI MIA 2 of SMAN 1 Campalagian. This study employed the Research and Development method using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. Observation, interview, and questionnaire were used to collect the data. The result of the study showed that the Physics learning module based on creative thinking was valid based on expert validation through the Gregory test so that this module is feasible to use. The results of the responses of 30 students and 4 teachers were in "good" category. Moreover, the students' learning outcomes increased after using Physics learning module based on creative thinking. This can be seen from the value of the posttest result that was higher than the pretest result. The average N-gain value obtained was 0.51 and this value was in the medium category (0.3 < g < 0.7). Therefore, it can be implied that the physics learning module based on creative thinking is one of the effective learning resources used to develop students' creative thinking skills, especially fluency, flexibility, originality, and elaborative thinking on the materials of mechanical waves, traveling waves, and stationary waves.*

Keywords: *creative thinking; physics learning; physics learning module*

I. INTRODUCTION

Education has an important meaning in life and become the main foundation in developing human resources. Therefore, education must be carried out as good as possible to obtain optimal results. In addition, education also has a very important role in developing the quality of human resources because education aims to form an individual who has the knowledge and skills (Bacanli et al., 2011).

Physics is a field of science that usually requires the students to be proficient and skilled in understanding and applying the concepts of physics that exist in everyday life, and be able to increase their potential in higher-order thinking. One example of higher

order thinking is the ability to think creatively (Fauziah et al., 2018).

One of the goals of learning science, especially physics, is helping the students to master various concepts and principles of physics science. This is intended to make students feel interested in studying physics further because they know that physics can explain various natural events and physics knowledge can be applied in technology (Chasanah et al., 2016; Nasar & Kurniati, 2020).

Problem solving skills are needed by students in learning physics because it can help the students to construct new knowledge and facilitate the physics learning (Mukhopadhyay, 2013)

According to Sohibi & Siswanto (2012), "Most schools do not encourage students to expand their thinking by creating new ideas and rethinking existing conclusions". Thus, the students' creative thinking skills need to be improved at schools by providing opportunities for students to figure out what is in their minds.

The creative thinking skills of students today seem less trained, especially in science subjects. Indeed, students' creative thinking is very necessary so that in learning students do not only focus on the materials from the books and the explanations of the teacher. Besides that, creative thinking skills are needed in society to prepare them to be able to compete with others. The students must be able to have any possible answers to a problem that is obtained or given. (Santika et al., 2016).

One of the efforts given done by the government is enhancing the teachers' quality by increasing their competencies, such as the ability to apply various learning theories in teaching, the ability to choose and apply the effective and efficient learning methods, and the most important is the teachers' creativity to stimulate the students to participate actively in learning. The learning activities in schools aim to improve the process skills and social skills of the students so that they can explore their creativities. The students' creativities are closely related to their creative thinking skills. In many aspects of life, whether at work or other activities, human resources with high-level skills are needed to maintain a habit of studying hard, reasoning, thinking creatively, making a decision, and solving any problems (Pusfarini et al., 2016).

Higher order thinking skills are very important for mental development and changes in students' mindsets to achieve successful learning. (Purnamaningrum et al., 2012). Unfortunately, learning activities in secondary schools nowadays still give emphasis on changing thinking skills at the basic level, not maximizing students' higher-order thinking skills.

In the development of the learning process, a teacher acts as a facilitator. This role provides opportunities for the teachers to facilitate the needs of their students as much as possible. Various learning media

innovations are carried out to promote the teacher's role as a facilitator. The use of media as a companion in the learning process is increasingly needed to overcome problems that arise due to limited time, place, and other facilities (Sukiminiandari et al., 2015).

The teachers give the big effort to improve the students' creative thinking skills; the efforts provided by teachers include the use of media in learning activities. The media does not only increase the quality of learning in education but also becomes a teaching tool that supports the teachers, as well as being a distributor of messages and other functions. Currently, the media as a mandatory teaching equipment should be given more attention by the teachers when carrying out the learning process in the classroom (Ariningsih, 2019).

Creative thinking is a person's ability to create ideas, either in the form of new works or a combination of new things with the existing ones, and anything that is different from the original form.

The improvement of students' creative thinking skills is a big effort given by educators, such as through the use of media or teaching materials in learning activities (Ariningsih, 2019).

Therefore, to support the learning process, it is very necessary to develop the teaching material to be more complete, concise, interesting, and creative to help the students understand the concept of the materials that they will get (Yulianto & Rohaeti, 2013).

According to the assessment of the National Education Standards Agency (BSNP), the good modules should meet the following criteria: the material should be suitable with the content of the module, the colors are suitable and can clarify the material, the color of the module title contrasts with the background color, there should be appropriate shape, color, and size, illustrations and picture captions, and placement of decorations/illustration on the background does not interfere the title, text, page numbers and others (Maymunah, 2017; Marisda, 2016).

A research which was conducted by Prastiwi et al., (2016) on the Development of Problem-Based Physics Modules to Improve High Order Thinking Skills (HOTS) of High School Students, shows that the validation score of problem-based physics learning modules from three validators, namely two expert lecturers and a physics teacher was 3.34 and categorized “good” and suitable for use in learning process. The HOTS of the students in the implementation phase obtained an N-gain of 0.585 and was included in the“moderate” category. Students’ responses to the problem-based physics learning module in the implementation phase obtained a percentage of 88.68% or in “very good” category. Thus, the problem-based physics learning module developed in this study is categorized as good and feasible to be used in learning and can improve High Order

Thinking Skills (HOTS) of high school students.

This was also supported by several previous researchers who used problem-based module development and found that the results of students' responses increased from "good" category to "very good" category. It is shown by the average score of 45 student questionnaires in the class trial. The score is 34 which is higher than the average student score obtained during the small trial, which is 29.30 from a maximum score of 40. Festiana et al., (2014) also revealed that the Problem-based physics module on dynamic electricity materials developed can improve students' creative thinking skills. There are four aspects of creative thinking skills, namely aspects of fluency, aspects of flexibility, aspects of originality, and aspects of elaboration. Aspects of fluency had the highest increase. The second leading improvement is in the originality aspect, followed by the elaboration aspect, and the flexibility aspect.

The application of the module has also been carried out by (Arumsari et al., 2014) regarding the development of a project-based learning module to optimize independence and physics learning outcomes in class X students of SMA Negeri 1 Kutowinangun in the academic year of 2013/2014. The results show that the module score is included in the "good" category and can be used as a learning medium with a little revision based on the validator's suggestions. The implementation of learning in four meetings obtained an average score of 97.75 from two observers and it was categorized as "very good". The aspect of optimizing the students' independence obtained a score of 78 and it was also categorized as "very good". Furthermore, the students' response to the developed module obtained a score of 78.31 and was in the "very good" category. Thus it can be concluded that the Project Based Learning-based module to optimize the independence and students' physics learning outcomes is feasible to be used as a physics learning medium, especially on the subject of optical instruments.

The results of the preliminary observation in SMA Negeri 1 Campalagian show that some teachers have not utilized a learning module based on creative thinking that can be used as independent learning resources by the students. In addition, the teachers revealed that curriculum 2013 requires the students to be active in the class. However, it has not been implemented during the learning process.

Some of the teaching materials that have been used in schools still cannot develop the students' understanding. Students were not used to thinking creatively in solving problems. If they did their task, they only answered the question based on what they had read in their textbook. Hence, many of the students could not construct the knowledge they obtained. The students also disclose that the learning process was not attractive at all, so it affected the students' learning outcomes.

Based on this background explanation, the researcher intended to conduct a research in the form of developing a physics module based on creative thinking. The objectives of this study are: (1) to develop a valid creative thinking-based physics learning module; (2) to find out the response of teachers/practitioners and students to the development of creative thinking-based physics learning modules; (3) to measure the effectiveness of the development of physics learning modules based on creative thinking.

II. METHODS

This research was conducted at SMAN 1 Campalagian, Polewali Mandar Regency, in the academic year of 2019-2020. The subject of this study was 30 students of class XI MIPA II. The selection of SMAN 1 Campalagian as the subject in this study was based on the results of the researcher's observations. The type of study used was Research and Development.

The design of Research and Development of Physics learning module based on creative thinking referred to the model development of ADDIE (Analysis, Design, Development, Implementation, and Evaluation) which was developed by Robert Maribe Branch (Sugiyono, 2017).

Based on the development model used, there were five stages of development carried out through the research process. It can be seen in Figure 1 as follows.

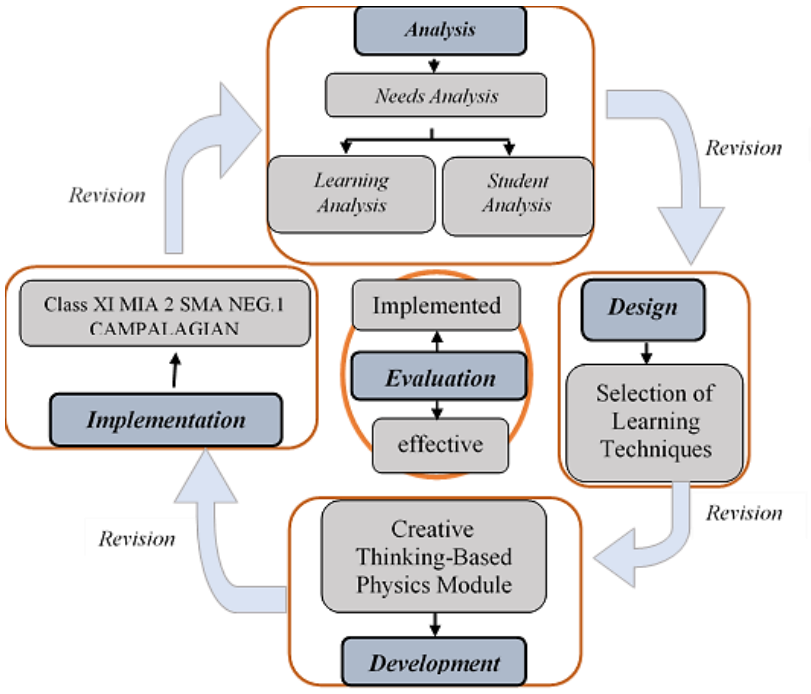

Figure 1. Design of Creative Thinking-Based Physics Module Development

The instruments that were used for collecting data in this study were (1) expert validation sheet, (2) questionnaire of teachers' responses, (3) questionnaire of students' responses, and (4) test.

The data from the experts validation on the development of Physics learning module based on creative thinking and other instruments were analyzed descriptively and qualitatively. The module rating scale includes: very appropriate, appropriate, less appropriate, and inappropriate with the indicators or aspects of being assessed (Retnawati, 2016)

The coefficient of content validity was determined through the results of the assessments of the two experts. These assessments were put into a 2 x 2 cross tabulation, as seen in table 1.

Table 1. Cross Tabulation (2 x 2) Experts Assessment

Assessment Tab from Practitioner/Educator 1		**Practitioner/Educator 1**	
		Weak relevance (score 1 or 2)	Strong relevance (score 3 or 4)
Practitioner/ Educator 2	Weak relevance (score 1 or 2)	A	B
	Strong relevance (score 3 or 4)	C	D

(Retnawati, 2016)

The calculation of content validity by two experts used construct validity as follows:

$$VC = (1)\frac{D}{A+B+C+D} \qquad 1)$$

The scale that was used to find out the respondents' responses was likert-scale. The guidelines for scoring the likert-scale are shown in Table 2.

Table 2. Conversion of Questionnaire Scores of Teachers' and Students' Responses.

Options	**Score**	
	Positive	**Negative**
Strongly Agree (SA)	5	1
Agree (A)	4	2
Neutral (N)	3	3
Disagree (D)	2	4
Strongly Disagree (SD)	1	5

(Riduwan & Sunarto, 2015)

The result of analyzing the score for each aspect assessed in the questionnaire then counted by using the following percentage formula.

$$\% = \frac{Score\ assigned\ to\ each\ category}{Total\ score\ of\ each\ category} \times 100\% \qquad (2)$$

The improvement of students' learning outcomes by using Physics learning module based on creative thinking that has been developed, can be seen from the results of the creative thinking test conducted before and after the learning process (Kristin et al., 2017). The level category of N-gain can be seen in the table 3.

$$g = \frac{Spost - Spre}{Smaks - Spre} \qquad (3)$$

Table 3. Level Category of N-gain put forward

Limitations	**Category**
0.70 g	High
0.30 < g < 0.70	Medium
g 0.30	Low

Haake in (Kristin et al., 2015)

III. RESULTS AND DISCUSSION

A. Result

1. The Profile of the Development of Physics Learning Module based on Creative Thinking

In developing the Physics learning module based on creative thinking, there are several aspects that need to be considered in validating process, namely the module instructions, the scope of the module elements, and the language used in the module.

The total average score of the three aspects assessed by the two experts was 3.43 with a percentage of validity of 85.83% (where each aspect obtained a percentage score > 75%), indicating that the Physics learning module based on creative thinking was in the "good" category.

The result of expert validation toward the Physics learning module based on creative thinking can be seen in table 4.

Table 4. The Profile of Physics Learning Module based on Creative Thinking

No	Aspects	Average for each aspect	Percentage (%)
1	Instructions	3.50	87.50
2	Scope of the elements	3.30	82.50
3	Language	3.50	87.50
Total		**10,30**	**257.50**
Total Average		**3.43**	**85.83**

2. The Responses of Teachers/Practitioners toward Physics Learning Module Based on Creative Thinking.

The data analysis on the responses of the four high school teachers/practitioners in Physics subject toward Physics learning module based on creative thinking showed that the attractiveness aspect gained a percentage of 72.50%, the content aspect gained 70.00%, the language aspect obtained 70.00%, and the benefit aspect obtained a percentage of 62.00%.

3. Students' Learning Outcomes after Using Physics Learning Module Based on Creative Thinking

The students' learning outcomes after using the physics learning module based on creative thinking was gained by comparing the result of pretest and posttest. Then, the result of pretest and posttest showed that there is an improvement in students' learning outcomes.

The level of N-gain stated by Haake was divided into 3 categories namely high, medium, and low. The result of the analysis of N-gain test showed that there are 20.00% of students' scores who were in high category and 80.00% of students' scores were in medium category. Based on the data analysis, the average value of g was 0.51 and this value was categorized as medium in the range of 0.30 g 0.70. The result of the analysis proved that the result value of posttest was higher than the result of pretest. The level of N-gain obtained from the test result of students' creative thinking is served in table 5.

Table 5. Level of category of N-gain

Limitstion	Category	Number of Respondents	Percentage (%)
g >0.70	High	6	20.00
0.30 < g < 0.70	Medium	24	80.00
g < 0.30	Low	0	0
Total		30	100.00

B. Discussion

This study employed a Research and Development method. The development of Physics learning module based on creative thinking was carried out by using the ADDIE development model. Referring to the ADDIE model development, the analysis stage is the initial stage. The analysis toward students' need on Physics learning module based on creative thinking was done in this stage.

1. The Profile of the development of Physics learning module based on creative thinking

The module developed focused on an important process called creative thinking. This module contains some pictures or problems that should be interpreted, so that the students can get used to think smoothly and flexibly. A few of questions are provided to help the students in practicing their abilities in thinking creatively. This module also offers the students worksheets containing experiments to help the students practicing their elaborative and original thinking skills.

There are some aspects that must be considered in developing the Physics learning module based on creative thinking, such as aspect of instructions, aspect of the scope of module elements, and aspect of language. The validation process is done by two experts namely evaluation expert and material expert of Physics learning. The result of validation showed that the Physics learning module based on creative thinking can be applied with few revisions.

The assessment results of the expert validators were then analyzed using construct validity to seek for the relevance of expert validity on Physics learning module based on creative thinking. Through the Gregory test, the coefficient of internal consistency was obtained; the two experts found that all items were in solid relevance.

Physics learning module based on creative thinking has met the criteria of validity and reliability. Therefore, Physics learning module based on creative thinking can be applied based on the general assessment from both validators.

2. Teachers' responses toward the development of Physics learning module based on creative thinking

The teachers/practitioners' responses toward Physics learning module based on creative thinking were obtained from four Physics teachers. Attractiveness, content, language, and benefits were the four aspects which were assessed.

The teachers assumed that the content and the language use of Physics learning module based on creative thinking could be clearly understood with interesting illustration/pictures in it. They also admitted

that the module was very helpful for the teachers in their teaching. The questionnaire covered the responses on how suitable and easy the teaching materials are applied. Rosalia & Isnawati (2018) states that the practicality of a teaching material means that it can be easily used in the teaching and learning process by the teachers and students.

Generally, the teachers gave very good or positive responses toward the Physics learning module based on creative thinking. Thus, it can be concluded that the Physics learning module based on creative thinking is very helpful for teachers in carrying out the teaching and learning process in class.

According to Wulandari et al. (2017), the teachers' responses are needed to find out the teachers' perception to the developed module. If the teachers' responses are in the good or very good category, then the module can be easily used in the teaching and learning process in the classroom.

3. Students' Learning Outcomes after Using the Physics Learning Module based on Creative Thinking.

There are 30 students in class XI MIA 2. The test items of the pretest and posttest refers to the cognitive aspects of C3 and C4 as well as to the four indicators of creative thinking ability. The students' ability in undertaking the C3 question (applying) could stimulate the students' original and elaborative answer because in responding any questions, the students are required to think differently from others or find the solutions of the problem by doing the detailed steps. In C4 questions (analyzing), there is a picture or problem that requires the students to give various interpretations and ideas, so that they can practice their ability to think fluently and flexibly.

The results of the overall N-gain test analysis showed that there were 20.00% of students in the high category and 80.00% of students in the medium category. Based on the analysis, the average value of g was 0.51 and this value was in the medium category in the range of $0.30 < g < 0.70$. The result proved that the posttest value was higher than the result of pretest. This result is supported by the study from (Kristin et al., 2015), who stated that that if N-gain achieve the average score of $0.3 < g < 0.7$, it is categorized as moderately normalized, and the product is considered as successful or improved.

Another research supporting the result is from Yanti et al., (2015) and Prihatiningtyas & Sholihah (2020) which investigated the development of problem-based high school/MA physics learning modules to improve students' critical thinking skills. This module has been tested to students of Class XI.1 and the results showed that the students' critical thinking improved by 39% and students' learning outcomes increased by 50%. This improvement can be seen from the different results of the pretest and posttest.

Furthermore, the similar research in developing a problem-based learning module

was also carried out by Hudha et al., (2017); however, he focused on improving students' physics problem solving ability. They found that students' responses to PBL-based physics modules in limited trials obtained percentages of 91% and 91.25% on the content and display components of the module.

This is also supported by research conducted by Hasanah et al., (2017) regarding the development of problem-based learning (PBL) physics learning modules on sound wave material for class XII high school students. The results of the research showed that the score for material aspect was 3.59 (appropriate category), the presentation aspect obtained a score of 3.9 (appropriate category), and the language aspect gained a score of 3.41 (appropriate category). In addition, the results of a limited trial reached an average score of 3.6 (appropriate category). Therefore, It can be concluded that the PBL-based physics learning module on Sound Wave material for class XII high school students is feasible to use.

From some of these things, it can be indicated that the physics learning module based on creative thinking is one of the effective learning resources used to develop students' creative thinking skills, especially fluency, flexibility, originality, and elaborative thinking.) on mechanical waves, traveling waves, and stationary waves.

IV. CONCLUSIONS AND SUGGESTION

The Physics learning module based on creative thinking could be applied in the teaching and learning process based on the revisions from the validators. The responses from the teachers indicate that this module is appropriate with the assessed and measurable criteria. Besides, the students also gave the good responses toward the module. They assumed that the Physics learning module based on creative thinking is an interesting module. Furthermore, the students' learning outcomes increased after using the Physics learning module based on creative thinking in the learning process. This proves that this module is suitable with the students' need and interest.

The module implementation process in this study was only carried out in one school, so that to find out the preferable improvement, the next researchers can implement this module to a larger number of subjects. Furthermore, the basic competencies used in the development of the module in this study are only three basic competencies in the second semester of class IX. Therefore, it is expected that the next researchers will be able to carry out the further research on other materials by using the Physics learning module based on creative thinking in Physics learning at schools.

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