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Development of an E-Module Based on the 5E Learning Cycle to Improve the Creative Thinking Abilities of Junior High School Students

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Abstract: A valid, practical, and effective learning cycle 5e-based e-module has been successfully developed. The method used is Development Research with the Rowntree development model which consists of three stages, namely the planning stage, the development stage, and the evaluation stage. The instruments used in this research are validity, practicality and effectiveness test instruments. The development process through content validity test, language, suitability of learning cycle 5E and creative thinking ability, practicality test, and field test. The results showed that the e-module developed had an average validity percentage of 4.03 with a good category. In the practically test, the e-module averaged 4.6 with a very practical category. The test of the effectiveness of the use of e-modules has an average n-gain of 0.7 with a high category of improving students' creative thinking skills.

Keywords: Creative thinking ability; Dynamic electricity; E-module; Learning Cycle 5E

Introduction

Science is learning that is directly involved in the process of exploring, discovering, and understanding scientific concepts or natural phenomena around us (Koja Kanga et al., 2022). The part of science that studies phenomena, events, or natural symptoms and reveals all the secrets and laws of the universe, namely the scientific field of physics, Giancoli (2014) states that physics is a basic science that focuses on the behavior and structure of matter. The substance of physics as a science is as a product (a body of knowledge), attitude (a way of thinking), and process (a way of investigation) (Chiappetta et al., 2010). Bahri (2017) stated that it takes a long time to directly understand abstract physics concepts. In fact, mastering several basic concepts is one of the main goals of learning physics (Diyana et al., 2020). In an effort to strengthen understanding of physics, in the learning process, students are required to be active so that knowledge can be built by the students themselves.

Dynamic electricity is a physics concept that is very useful in everyday life, especially in relation to the use of equipment that uses electrical energy. According to Hasbi (2015), the results of a preliminary study found several problems in learning dynamic electrical concepts in schools that need to be corrected. The problems that occur are dynamic electricity learning still uses teacher-centered lecture methods, there is a lack of support for science equipment for carrying out electricity practicums and mastery of dynamic electricity concepts in schools is not optimal, as seen from the results of the student's final evaluation. This problem is in line with the opinion of Leasa (2016), which states that in the learning process, students tend to be less encouraged to develop thinking skills; however, they place more emphasis on memorization. In fact, according to Wartono (2018), students who are accustomed to

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learning by memorizing without understanding will result in the material becoming meaningless and reduce creative thinking.

Creative thinking is a series of processes, namely understanding problems, making conjectures and hypotheses about problems, looking for answers, proposing evidence, and reporting results (Suherman & Vidákovich, 2022). So it can be concluded that creative thinking is the ability to analyze something based on data or information to produce new ideas (Batlolona et al., 2019). According to Nikkola (2020), the indicators of creative thinking proposed by Torrance (1972) are as follows: Thinking fluently (fluency); Thinking flexibly; and Thinking original (originality). Thinking in detail (elaboration). According to Hidayat and Widjajanti (2018), middle school students still have the ability to think creatively mathematically at 47.2%. This shows that the ability to think creatively at the junior high school level is in the low category. Students' creative thinking abilities can be developed by involving them directly in scientific activities. One form of learning model that can stimulate students' creative thinking abilities is the 5E Learning Cycle model.

Model learning *cycle 5E is* a learning model that is centered on students. Model learning *cycle 5E consists* of five stages, namely the engagement stage, exploration stage, explanation stage, elaboration stage, and evaluation stage. Learning *cycle 5E* is a learning model where students can play an active role in learning with organized stages so that they can easily master the competencies that must be achieved (Fajaroh and Dasna, 2007).

Dwi (2013) states that to design innovative learning that can improve creative thinking abilities, we must use effective strategies. One of your strategies To support the learning process, prepare a module. Modules are a form of independent learning resource that can be adapted to the characteristics of students (Prasetya, 2012). This was also conveyed by Auliya (2017), who stated that apart from being useful for helping teachers deliver material, modules must also be able to function to develop thinking skills according to personal abilities, reduce dependence on teachers, and make it easier for students to learn each competency.

One of the teaching materials that we can and have developed is e-modules. It is hoped that the e-module can attract students' interest in learning and can describe abstract material (Sriyanti et al., 2021). E-modules have advantages over printed modules, namely that they can make the learning process more interesting and interactive, can convey historical messages through pictures and videos, encourage student learning through interactive features, and can develop students' sense of hearing so that the material presented is easier to understand.

The e-learning modules published by the book center are quite good. However, the presentation of the material still uses representations in the form of still images, and the formulas and problem-solving are less interactive. The e-modules that have been published are not able to help students actively carry out activities such as the 5E learning model. Through the activities carried out by students, they can improve their creative thinking abilities. From this research, the researcher developed an e-module based on Learning Cycle 5E to improve junior high school students' creative thinking abilities on the topic of dynamic electricity, which can be accessed using a mobile phone.

Method

Research on e-modules based on the 5E learning cycle to improve creative thinking skills on dynamic electricity topics was carried out at SMPN 4 Muara Sugihan in July–September 2023 for the 2023–2024 academic year. The subject of this development research is an e-module based on Learning Cycle 5e to improve creative thinking skills on the topic of dynamic electricity for class IX C students at SMPN 4 Muara Sugihan.

The research was carried out using the *Development Research* method with the Rowntree development model, which consists of 3 stages, namely: the planning stage; the development stage; and the evaluation stage. Meanwhile, at the evaluation stage, Tessmer's formative evaluation model is used, which consists of five stages, namely: self-evaluation; expert review; one-to-one evaluation; small groups; and field tests. Tessmer's (1998) formative evaluation is used to ensure that the resulting product has high validity and practicality.

Planning Stages

The planning is intended so that the e-module developed is appropriate and on target. Planning begins with analyzing the needs of students. reviewing theories related to the development of teaching materials, looking for references to relevant research results such as journals, theses, and books, and conducting informal interviews with several students at SMPN 4 Muara Sugihan. The results of the needs analysis, as explained previously, will be a strong basis for developing e-modules. Then the researcher also carried out an analysis of the 2013 curriculum syllabus as well as a concept analysis on the subject of dynamic electricity, which is attached to the design attachment. Based on this, the researcher then formulated learning objectives.

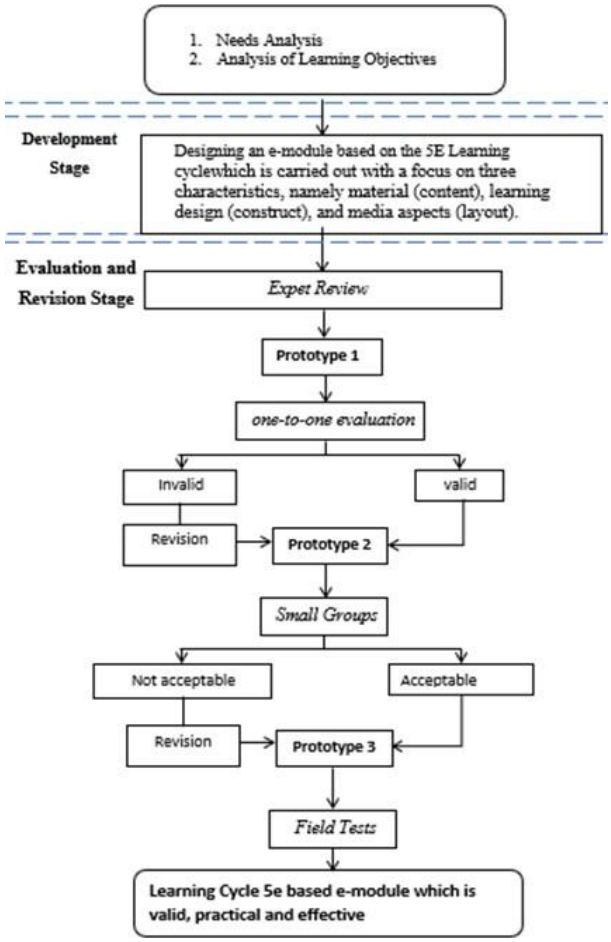

Figure 1. Development Research Flow (modification of Rowtree Tessmer)

Development Stage

The development stage is where this stage aims to design prototype 1 e-module. The development stage consists of topic development and drafting. On topic development, outline the contents of the e-module, and storyboards for e-modules are prepared. The purpose of preparing an outline of the contents of the e-module and storyboard is to serve as a guideline in making the design and provide an overview of what will be arranged in the e-module. The outline of the contents of the e-module, storyboard, and dynamic electrical concept map can be seen in the design attachment.

Then, the researcher drafted the components that would be included in the e-module prototype. The components that will be created include the cover, production identity, foreword, table of contents, instructions for use, content competencies, basic competencies, concept map, materials, activities, evaluation, bibliography, and glossary. After going through the preparation process, the draft is then completed and edited according to the e-module product that you want to develop using the Adobe Flash Professional CS6 program facilities to input several aspects, including text, images, animation, video, audio, and virtual lab.

Evaluation Stage

The e-module that has been created is then tested empirically (evaluation) using formative evaluation from Tessmer to determine the validity, practicality, and effectiveness of the e-module on the subject of dynamic electricity. Meanwhile, at the evaluation stage, feasibility tests were carried out, including content validity tests, readability, suitability of the 5E learning cycle, and creative thinking skills by one expert, media practicality tests by one expert, and field trials by one physics teacher and 28 students.

The data collection techniques used were walkthroughs and questionnaires. The walkthrough technique is carried out with experts who are used to determine the validity of the product and make suggestions that help in product development so that the product will be better. Meanwhile, the data collection technique using a questionnaire aims to determine the practicality of the e-module prototype from the student's perspective. The data collection instruments are validation questionnaires and practicality and effectiveness analyses based on the results of post-test and pre-test comparisons. The grid used in the e-module validity and practicality questionnaire is as follows:

Table 1. E-Module Content Validation Instrument Grid

Indicator	Statement Number
Suitabilitye-module materialwith KI, KD and learning objectives	1, 2
Accuracy of learning materials	3, 4
Sophistication of learning materials	5, 6,7
Benefits for insight and encouraging curiosity	8,9,10,11,12
Clarity of information	13

(Azairok et al., 2023)

Table 2. E-Module Language Validation Instrument Grid (Department of National Education, 2008)

Indicator	Statement Number
Legibility	1, 2
Conformity with correct Indonesian language rules	3, 4.5
Effective and efficient use of language	6,7

Table 3. 5E Learning Cycle Validation Instrument Grid

Indicator	Statement Number
Engagemnet (interest generation)	1,2
Exploration (investigation)	3
Explanation (explanation)	4
Elaboration (communicating)	5

(Astriani, 2017)

Table 4. Creative Thinking Skills Feasibility Validation Instrument Grid

Indicator	Statement Number
Fluency thinking skills	1,2,3
Flexible thinking skills (flexibility)	4,5,6,7
Original thinking skills (originality)	8.9
Elaboration skills	10,11

(Torrance, 1972)

Table 5. E-Module Design Validation Instrument Grid

Indicator	Statement Number
Serving order	1
Design the cover and contents of the module	2,3, 4
Font usage (type and size)	5,6
lay out(layout)	7.8

(Department of National Education, 2008)

Table 6. Instrument Grid Questionnaire for student responses to the practicality of e-modules

Indicator	Statement Number
Accuracy of Material	1
Benefits for insight and encouraging curiosity	2
Clarity of information	3
Sophistication of material	4
Use of language effectively and efficiently	5,6
Font usage (type and size)	7
Cover design and module content (Image, Animation, Video and Audio)	8
Lay out	9
Completeness of information	10
Engagemnet (interest generation)	11
Exploration (investigation)	12,13
Explanation (explanation)	14
Elaboration (communicating)	15
Evaluation (assessment)	16
Fluency thinking skills	17
Flexible thinking skills (flexibility)	18
Original thinking skills (originality)	19
Elaboration skills	20

(Department of National Education, 2008)

The validation sheet given to the validator is in the form of the following Likert scale:

Table 7. Expert Validation Questionnaire Likert Scale

Answer Categories	Scale
Very suitable	5
In accordance	4
Suitable enough	3
Not Appropriate	2
It is not in accordance with	1

(Modification of Sugiyono (2013) in(Azmi, 2022)

The validation and practicality data obtained will then be managed using the following formula:

$$\bar{X} = \frac{\sum x}{n} \quad (1)$$

Information:
$\bar{X}$ =average score
$\sum x$ = total score for each indicator
n = number of indicators

The results of data processing will then be converted into the table categories below:

Table 8.E-Module Category based on Expert Validation

Answer Categories	Scale
Very Valid	4.2 <5.0 $\bar{X}\leq$
Valid	3.4 < $\bar{X}\leq$ 4,2
Fairly Valid	2.6 < $\bar{X}\leq$ 3,4
Less Valid	1.8 < $\bar{X}\leq$ 2,6
Very Invalid	1.0 < $\bar{X}\leq$ 1,8

(Widoyoko (2017) in(Azmi, 2022)

Table 9. E-module categories based on teacher and student responses (Wiyono, 2015)

Answer Categories	Scale
Very Practical	4.2 <5.0 $\bar{X}\leq$
Practical	3.4 < $\bar{X}\leq$ 4,2
Quite Practical	2.6 < $\bar{X}\leq$ 3,4
Less Practical	1.8 < $\bar{X}\leq$ 2,6
Very Less Practical	1.0 < $\bar{X}\leq$ 1,8

Meanwhile, to measure the effectiveness of using the module, researchers used the N-gain score calculation (Hake, 1998) by using the Formula 2:

$$(g) = normalized\ gain = \frac{posttest - pretest}{skor\ maksimum - pretest} \quad (2)$$

Table 10. Gain Classification

Average Normalized Gain	Classification
$(g) \geq 0{,}70$	high
$0{,}30 \leq (g) < 0{,}70$	Currently
$(g) < 0{,}30$	Low

(Hake, 1998)

Results and Discussion

The research carried out has produced an e-module based on the 5E learning cycle to improve creative thinking skills on the topic of dynamic electricity at the junior high school level. The e-module has been empirically tested (evaluation) using a formative evaluation from Tessmer to determine the validity, practicality, and effectiveness of using the e-module on the subject of dynamic electricity. The first stage in

Tessmer's formative evaluation is the self-evaluation stage. After checking, the researchers found several errors, such as the virtual lab navigation buttons not functioning optimally, the animation display not being clarified, video playback automatically, the e-module display not being optimal, and several editorial errors in the sentences in the evaluation section.

Next, the e-module is given to experts to view and validate. The results of the e-module validation can be seen in the following Table 11.

The validation results for the content aspect were 3.72, or 74%, in the good category. The results of linguistic validation are 4, or 80%, in the good category. The validation results for the 5E learning aspect are 3.8 in the good category. Meanwhile, design validation is 4.5, or 90%, in the very good category. So that a validator assessment of the content and design aspects, which include content, design, language, Learning Cycle 5E, and the feasibility of creative thinking in the e-module, can be produced, If we convert this percentage, it can be concluded that e-modules have a level of suitability or accuracy as teaching materials of 80.5%, with the category being a product with good validity.

Table 11. Results of Validator Assessment of Prototype 1 E-module Based on 5E Learning Cycle to Improve Creative Thinking Ability

Validator (Expert)	Indicators/ Aspect assessed	Average Score	Percentage (%)
Validator 1	Content Aspect		
	Suitability of e-module material with KI, KD and learning objectives	4	80
	Accuracy of learning materials	3.5	70
	Sophistication of learning materials	3.6	72
	Benefits for insight and encouraging curiosity	4	80
	Clarity of information	3.5	70
	Content Aspect Average	3.72	74
	Language Aspects		
	Legibility	4	80
	Conformity with correct Indonesian language rules	4	80
	Use of language effectively and efficiently	4	80
	Language Aspect Average	4	80
	Aspects of 5E Learning		
	Engagemnet (interest generation)	4	80
	Exploration (investigation)	4	80
	Explanation (explanation)	4	80
	Elaboration (communicating)	4	80
	Evaluation (assessment)	3	60
	Average of 5E Learning Aspects	3.8	76
	Feasibility Aspects of Creative Thinking		
	Fluency thinking skills	4	80
	Flexible thinking skills (flexibility)	4	80
	Original thinking skills (originality)	3.5	70
	Elaboration skills	4	80
	Aspect AverageCreative Thinking	3.9	78
Validator 2	Design Aspects		
	Serving order	4	80
	Design the cover and contents of the module	4.6	92
	Font usage (type and size)	4.5	90
	lay out(layout)	5	100
	Design Aspect Average	4.5	90
	Average Total E-module Assessment	4.03	80.5

Table 12. Student Response Questionnaire Assessment Results

Indicators/Aspects assessed	Average Score	Percentage (%)
Material Aspects (Content)		
Accuracy of Material	4.6	92
Benefits for insight and encouraging curiosity	4.6	92
Clarity of information	4.6	92
Sophistication of material	4.6	92
Use of language effectively and efficiently	4.8	96

Indicators/Aspects assessed	Average Score	Percentage (%)
Font usage (type and size)	4.3	86
Cover design and module content (Image, Animation, Video and Audio)	4.3	86
Lay out	4.6	92
Completeness of information	5	100
Engagemnet (interest generation)	4.8	96
Exploration (investigation)	4.8	96
Explanation (explanation)	5	100
Elaboration (communicating)	5	100
Evaluation (assessment)	4	80
Fluency thinking skills	5	100
Flexible thinking skills (flexibility)	4.8	96
Original thinking skills (originality)	5	100
Elaboration skills	4	80
Average Total Score	4.6	93%

Based on Table 12, it is found that the average questionnaire assessment of student responses to the use of e-modules is 4.6. If we convert this percentage, it can be concluded that e-modules have a level of ease of use of 93%, with the category being a very good product. practicality for application in the classroom. This, too, is in line with research by Putri et al. (2018), which illustrates that the e-module developed can be used easily in the learning process if the percentage of practitioner assessments obtained is > 80%.

Table 13. N-Gain results to see student effectiveness

	Pre-Test	Post-Test	N-gain	Kategori
Maximum	50	95	0.9	high
Minimum	0	64	0.64	Currently
Average	25	77.7	0.70	high

Aspects of effectiveness can be determined based on the level or degree of product application (Rochmad, 2012). The effectiveness of e-module learning can be measured by looking at the increase in post-test and pre-test results. In line with this, Kartika (2001) stated that a learning process is said to be effective if 60% of students can complete the minimum completeness criteria. So, based on the analysis of Table 13, it can be seen that the normalized gain value for class XI C, which uses e-modules in the learning process, is 0.70. If we convert this percentage, it can be concluded that the e-module product increases creative thinking skills in its use by 70%, with the category being a product with high effectiveness for application in the classroom.

These data show that learning cycle 5E e-module has been developed can help students and teachers in physics learning so that they can understand physics concepts and improve creative thinking skills. In addition, many more conveniences are presented in order to improve the creative thinking skills of students such as the existence of discussion, examples, simulations, exercise, and learning videos (Nurhaisa et al., 2023). The 5E learning cycle learning model that is applied in the learning process in the classroom is a learning strategy that has a logical and interesting sequence in presenting learning material (from easy to difficult and from simple to complex) with variations in continuous evaluation methods, fast feedback to encourage students to continue to acquire and study scientific concepts. The interaction between the 5E learning cycle strategies can reduce boredom and help students continue studying for a longer period and thus learn more scientific concepts. Constructive learning and the 5E learning strategy which has two active processes, in which scientific knowledge is included in student knowledge and regarding the need to arrange the sequential presentation of dynamic electric material so that students will be active to obtaining into knowledge (Qawasmeh et al., 2017).

The results of these findings are in line with several previous studies that also produce similar products, Moodle-based e-learning developed in the category according to all aspects, effective and practical, so that it is feasible for use in physics learning (Yusuf et al., 2020), valid and practical e-learning-based distance learning design (Martini et al., 2021).

Conclusion

According to the findings of the research, the development of e-modules based on the 5E learning cycle to strengthen the creative thinking abilities of junior high school students is appropriate for use as teaching material for students based on: The expert review results suggest that the developed e-module based on the 5E learning cycle to boost the creative thinking abilities of junior high school students has a degree of applicability or accuracy as a teaching material of 80.5% with good validity. The results of the questionnaire Student answers in the small group e-module stage based on the 5E learning cycle to improve junior high school students' creative thinking abilities

had an ease of use level of 93% with a very good practicality category. The results of the normalized gain analysis at the field test stage indicate that the e-module based on the 5E learning cycle to improve the creative thinking abilities of junior high school students has an effectiveness level of 70%, placing it in the high category of effectiveness for classroom application.

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Conceptualization, M. K, I, I. S.; methodology, M. K, I, I. S.; validation, L. M, and K. W.; formal analysis, M. K.; investigation, M. K.; resources, M. K.; writing – review and editing, M. K., I., I. S.; visualization, M. K. All authors have read and agreed to the publish version of the manuscript.

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The author declares no conflict of interest. In the data published in this article, both in data collection, analysis, and interpretation, in writing manuscripts, or in the decision to publish research results, there is no conflict of interest with any party.

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