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CREATIVE PROBLEM SOLVING-BASED ELECTRONIC MODULE INTEGRATED WITH 21ST CENTURY SKILLS

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ABSTRACT

Teachers as facilitators in learning are expected to develop learning that integrates 21st-century skills so that students are ready to compete in this era. One of the things teachers can do is develop e-modules based on the Creative Problem Solving (CPS) model. This research is research and development with 4D models. The purpose of this study is to produce an integrated 21st-century physics e-module based on the CPS model. Data analysis using descriptive analysis. Research results: E-module physics based on CPS model integrated 21st-century skills have met the valid criteria: for the content, feasibility component is in the very valid category with a value of 93.18, the presentation component is in the very valid category with a value of 85, the graphic component is in the category very valid with a value of 95.45, and the language component is in the very valid category with a value of 83. Therefore, this CPS-based e-module has met the criteria to be piloted in schools.

MODUL ELEKTRONIK BERBASIS PEMECAHAN MASALAH KREATIF TERINTEGRASI DENGAN KETERAMPILAN ABAD 21

Kata Kunci:

CPS
Modul elektronik fisika
Keterampilan abad 21

ABSTRAK

Guru sebagai fasilitator dalam pembelajaran diharapkan mampu mengembangkan pembelajaran yang mengintegrasikan keterampilan abad 21 agar siswa siap bersaing di era ini. Salah satu hal yang bisa dilakukan guru adalah mengembangkan e-modul berbasis model *Creative Problem Solving* (CPS). Penelitian ini merupakan penelitian dan pengembangan dengan menggunakan model 4D (Thiagarajan). Tujuan penelitian ini adalah menghasilkan e-modul pembelajaran fisika terintegrasi abad 21 berbasis model CPS. Analisis data menggunakan analisis deskriptif. Hasil penelitian: E-modul fisika berbasis model CPS terintegrasi keterampilan abad 21 telah memenuhi kriteria valid: untuk komponen kelayakan isi berada pada kategori sangat valid dengan nilai 93,18, komponen penyajian berada pada kategori sangat valid dengan nilai 85, komponen kegrafikan berada pada kategori sangat valid dengan nilai 95,45, dan komponen bahasa berada pada kategori sangat valid dengan nilai 83. E-modul berbasis model CPS sudah memenuhi kriteria untuk diujicobakan di sekolah.

1. INTRODUCTION

The 2013 curriculum emphasizes 4 important things, namely character education, literacy, 21st Century Skills, and High Order Thinking Skills (HOTS)[1]. 21st-century skills are important to be integrated into learning because Indonesia has entered the era of globalization, where Indonesian graduates must be able to compete internationally[2]. The condition of Indonesian human resources does not yet have competitiveness when compared to other countries[3]. Human resources that have competitiveness in the era of globalization are human resources that master 21st-century skills[2]. The role of education is very important in preparing competitive human resources. The implementation of the 2013 curriculum which emphasizes the integration of 21st-century skills is one of the right steps to prepare the next generation to face global competition in the 21st century. 21st century skills needs to be included in the curriculum so that every learning process can prepare students to be able to compete globally in the future.

The development of 21st-century skills needs to be supported by the application of learning models. One of the suggested learning models for 2013 curriculum learning is problem-based learning[4]. Creative Problem Solving Model (CPS) as a type of problem-solving model can develop students' ability to think critically and creatively so that they can solve problems with many solutions.[5]. In addition, the learning step with CPS allows students to work in groups (collaborate) and communicate ideas and solutions obtained. [6]. CPS steps facilitate students to be more critical in assessing a problem, more creative in choosing problem solutions, more communicative in expressing opinions regarding solutions to problems, and able to work together in teams. So the CPS model really supports students in mastering 21st century skills as a whole.

The problem that is often found in schools is the lack of learning resources that support the achievement of competencies and are not following the character of the students/environment. The teaching materials used are generally accepted teaching materials, not referring to the characteristics of students. Teachers are expected to develop teaching materials as learning resources [7]. One of the newest forms of teaching materials today is the e-module. Through learning with E-modules, learning patterns that allow students to learn independently and teachers are no longer the only sources of learning[8]. The material in the E-Modul makes it easier for students to understand the explanation of the material because there is a mixing of multimedia elements into the E-Modul. CPS steps facilitate students to be more critical in assessing a problem, more creative in choosing problem solutions, more communicative in expressing opinions regarding solutions to problems, and able to work together in teams. So the CPS model really supports students in mastering 21st century skills as a whole.

The developed e-module should meet the criteria of good quality. The criteria consist of validity, practicality, and effectiveness [9]. Validity is related to the correctness of the product being developed. Especially for educational products, validity consists of several components: content feasibility, presentation, graphics, and language. Validation is assisted by competent experts in their respective fields.

The e-module was developed using the "flipbook" application. The physics e-module was developed based on the CPS model. The material is arranged based on the steps of the CPS model, namely: explore the vision, gather data, formulate the challenge, explore ideas, formula solutions, and implement formulas[10]. In addition, the e-module also integrates 21st-century skills in each module. Previously, there have been several researchers who have conducted similar research, including 1) Sri Mayanty et al, researched the development of Problem Based Learning (PBL) Physics-Based E-modules to Improve Science Process Skills for High School Students. very valid and practical to

use in learning, 2) Eka Syafutri et al, researched the development of interactive physics e-modules on Dynamic Fluids using the SETS approach, the results of this study showed that this e-module met the criteria of being valid, practical, and effectiv [11], [12]. The novelty that the author brings in this research is to develop an e-module based on CPS and integrate 21st-century skills. The author develops an e-module based on the CPS model by integrating 21st century skills, so that students who learn to use this e-module can solve problems creatively and master 21st century skills as a whole as a preparation to compete in the future. Currently, the choice of digital teaching materials is not too many and has not facilitated students to master 21st century skills, so researchers have developed an integrated CPS-based physics e-module for 21st century skills that meets valid criteria.

2. METHOD

This research method is research and development. This study uses the Reeve model which consists of 4 steps according which is shown in Figure 1.

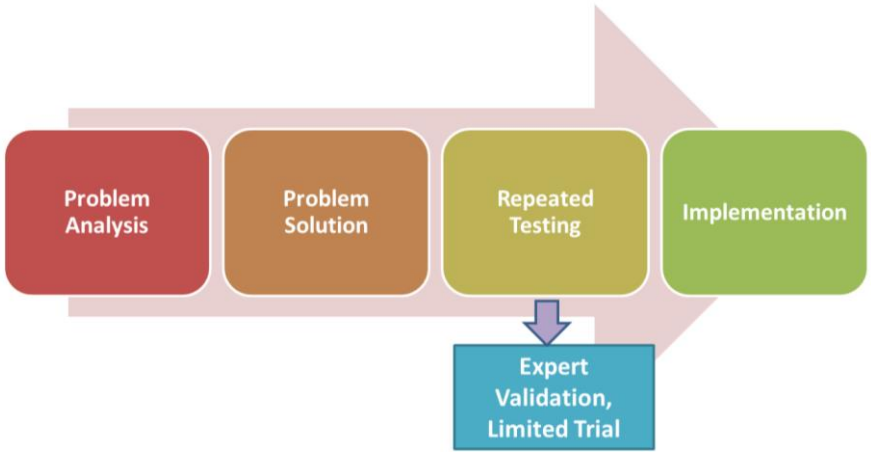

Figure 1. Research Path (Taken from Educational Design Research by McKenney & Reeves) [13]

This research was conducted in accordance with the development steps by McKenney and Reeves model consisting of: 1) problem analysis: at this stage a needs analysis was carried out: curriculum analysis (analysis sheets) and student analysis (questionnaires), 2) problem solutions (designing e-modules). according to the 21 century skill integrated CPS step), 3) repeated testing: expert validation, limited trial, 4) implementation[14]. Due to time constraints, this research has only been completed until the validation test stage. The description of the results of problem analysis and problem solutions have been described in previous publications.

Data collection related to the quality of the developed e-module lies in the Repeated Testing stage. The e-module validation is assisted by 4 validators: 1) Content Eligibility Validator, 2) Presentation Validator, 3) Graphic Validator, and 4) Language Validator. The data collection instrument is a validation questionnaire. This questionnaire uses a Likert scale of 1-4, with 1: strongly disagree, 2: disagree, 3: agree, and 4: strongly agree. data analysis using the following equation:

$$V = \frac{n}{n_{max}} x\ 100 \qquad (1)$$

with:

n : the score given by the validator
n_{max} : highest score
V : validity score

The criteria for the level of validity can be seen in Table 1 below.

Table 1. Validity Score Interpretation Criteria [15]

Score	Criteria
0 - 20	Very invalid
21 - 40	Invalid
41- 60	Moderate
61 - 80	Valid
81 - 100	Very valid

The e-module has been revised several times in accordance with the suggestions given by the validator. The instrument used is the validity of the questionnaire. Analysis of the data used is descriptive analysis.

3. RESULTS AND DISCUSSION

3.1 E-modul Overview of Physics-Based Creative Problem Solving (CPS) E-modules Integrated with 21st Century Skills

This study begins with an analysis of the needs of teaching materials in schools. The analysis carried out consisted of curriculum analysis, material analysis, and student analysis. Curriculum analysis uses analysis sheets, and information is obtained that most of the final skills mastered by students are application and analysis, therefore the application of the CPS model is a must because CPS can help students think critically and creatively to solve the problems they find. On the other hand, integrating 21st century skills in learning also supports the achievement of learning objectives: creative in application and critical in analyzing. The results of the material analysis show that most of the Physics material in class XI SMA (senor high school) is procedural material concerning the laws of Physics, so a learning model is needed that helps students understand the material. The results of student analysis showed that students expected teaching materials that matched their desired learning style, could be accessed anywhere, helped them when studying independently at home, and they were also interested in knowing more about 21st century skills[16]. Based on the results of the analysis above, information is obtained that it is necessary to develop integrated teaching materials for 21st-century skills based on the CPS model in the form of e-modules.

In the next stage, the design of the e-module is carried out using the flipbook application. The results of the design of the e-module that we developed are shown in Figure 2.

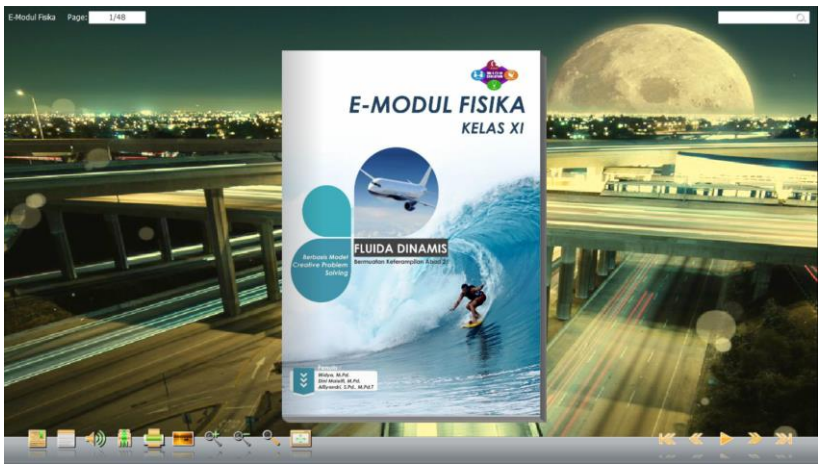

Figure 2. Cover of E-module[17]

The Physics E-module was developed by integrating the Creative Problem Solving (CPS) model in learning. All steps of the CPS model are integrated into the e-module. The CPS steps that are integrated into learning include: 1) Explore the Vision: aims to tell what the learning objectives are in each module, 2) Gather data: students are asked to collect data related to the concept to be studied, 3) Formulate the Challenge: contains the formulation problems that will be solved by students in each module, 4) Explore Idea: each module displays material related to the given problem, and becomes a material for students to consider in choosing the given solution, 5) Solution Formula: students are asked to discuss with their friends to find solutions to problems, 6) Implement Formula: contains the best solution obtained when it is decided through class discussion. In addition, in each module, 21st-century skills are also integrated [17].

In addition, this e-module is also equipped with a video containing facts so that students feel closer to the material being studied. Figure 3 shows a video display in a CPS-based physics e-module.

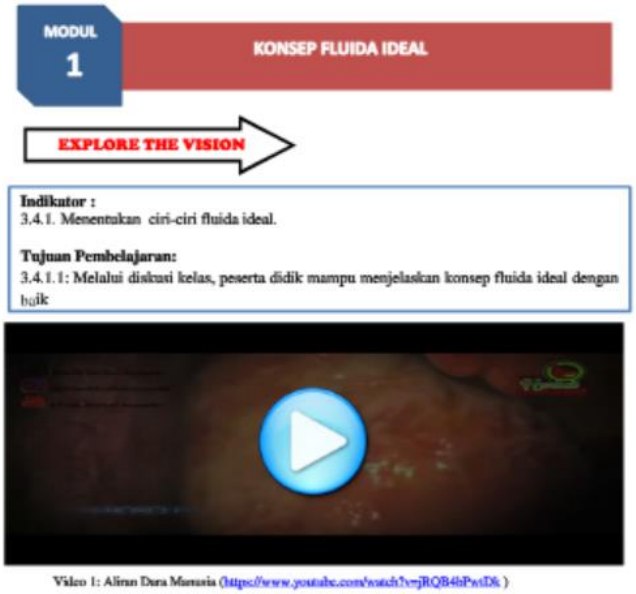

Figure 3. Video on The Module

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3.2 E-Module Validation Results

3.2.1 Video Display in E-module

The following table shows the results of the e-module validation for the content eligibility category.

Table 2. Results of The E-module Validation for The Content Eligibility

No	Statements	Score
1	The topics presented in the e-module are in accordance with the demands of KI, KD, and the formulated indicators	100
2	The facts presented are in accordance with the topic	100
3	The facts presented are in accordance with the theory	75
4	The concepts presented are not ambiguous	100
5	The material provided is in accordance with the Dynamic Fluids material	100
6	The examples provided are up to date and contextual	100
7	The description of the material and examples provided are relevant and attracts students' attention	100
8	Examples of questions given can help students understand materials	75

9	E-modules are developed based on the Creative Problem Solving (CPS) model	75
10	The steps of the CPS model are clearly visible in the e-modules,	100
11	21st-century skills are integrated into e-modules as a whole	100
	Average	93,18

Based on the data in Table 2, information is obtained that the e-module is very valid for the content feasibility category with an average value of 93.18. Some e-module statements get a maximum score and 3 e-module validation statements for content eligibility get a score of 75. The suggestions given by the content feasibility validator are: explore the vision and "data gathering" need to be given "standard" or keywords for the material to be data is collected. The follow-up is to add information to the data gathering section and explore the vision. These results indicate that the e-module developed is in accordance with the demands of the curriculum, the facts presented are in accordance with the topic and theory, the examples provided are up to date, the learning steps in the e-module have been developed based on CPS, and 21st-century skills. already integrated dam e-module. E-module Physics for Dynamic Fluids has been developed by taking into account the eligibility criteria for the content of a teaching material[18]. This is in line with the research conducted by Nurul Fadieni and Ahamad Fauzi who developed an Integrated Physics E-Module on Experiential Learning-Based Lightning Disaster Material which has a valid value for valid content eligibility.[19]. This is because the content of teaching materials has been developed according to the demands of the curriculum and the suitability of the material with the level of student development [20], [21].

3.2.2 Presentation

Table 3 shows the results of the e-module validation for the presentation category.

Tabel 3. E-Module Presentation Validation Results

No	Statements	Score
1	The sentence structure is not ambiguous and creates confusion,	75
2	CPS-based e-modules containing 21st-century skills contain a clear subject of learning objectives	100
3	CPS-based e-modules contain 21st-century skills directing students to build their concepts	100
4	The presentation of the material scheme is following the characteristics of the material,	75
5	The order of presentation is following the indicators and subject matter	75
	Average	85

Based on Tabel 3, information is obtained that the e-module is very valid for the presentation category with an average value of 85. This is because the e-module has been arranged based on the order of the components of teaching materials, the material scheme is presented according to the characteristics of the material, the material is presented following achievement of indicators, teaching materials have been developed following the steps of the CPS model [22]–[24]. This is in line with the results of the study by Santri Yuli Ernica who developed an e-module on a colloid system based on a scientific approach that the presentation of the e-module obtained an average score of 0.83 with a very high validity category, this is because the e-module has been developed according to the steps scientific approach [25].

3.2.3 Graphics

Table 4 shows the results of the e-module validation for the graphics category.

Table 4. E-Module Presentation Validation Results

No	Statements	Score
1	The e-module introduction page consists of a cover, instructions for using the module, information on 21st century skills and a table of contents	100
2	The e-module page is presented systematically, starting from the title, learning materials, and sample questions	100
3	On the closing page e-module contains a bibliography	100
4	The description of the material in the learning model is adjusted to the creative problem solving (CPS) model	100
5	Consistent in using symbols/symbols l	100
6	There is a balance between illustrated images and text	100
7	There is a balance between illustrated images and text	75
8	The font used is clear and legible	100
9	The layout is organized	100
10	The display design is simple and attractive	100
11	The videos and images displayed are clear	75
	Average	95,45

Based on Table 4, the e-module gets a very valid score for the graphic category with a value of 95.45. This is due to several things: the teaching materials developed have been arranged based on a good module structure, the cover is presented using attractive images, the balance between the presentation of images and writing, using colors that inspire enthusiasm for learning [25], [26]. This is in line with the results of Febriyandi's research in developing an integrated inquiry-based integrated virtual laboratory on colloid system material[28]. The developed e-module already has a clear and attractive appearance. Attractive e-modules can increase students' motivation to learn and allow students to learn independently [29].

3.2.4 Language

Table 5 shows the results of the e-module validation for the Language category.

Table 5. Language Validation Results in E-Modules

No	Statements	Score
1	E-module uses communicative language	75
2	E-module contains language that can motivate students to learn	100
3	The language in the e-module is a good and correct language according to Indonesian grammar rules	100
4	The information conveyed is clear	75
5	The spelling used refers to the General Guidelines for Indonesian Spelling	75
6	Consistent in using terms that describe the concept	75
	Average	83,33

Based on Table 5, the e-module gets a very valid score for the language category. This is due to several things: the e-module uses a communicative language, the e-module has used a language that can motivate students, the language used is good and correct, the spelling refers to the correct reference. [30]. This is in line with the results of research by Silvi Trisnaa who conducted research related to the development of guided inquiry-based learning modules on fluid materials which resulted in a module with a validation rate of 81.68%.[31]. The use of appropriate and efficient language in teaching materials can speed up the learning process [31].

Based on the validity of the data above, information is obtained in the form of the developed e-module that has met the valid criteria consisting of the feasibility of content, graphics, language, and presentation. The e-module has gone through several revisions, and the average score is in the very valid category. Teaching materials/e-modules that have been declared valid can be tested in learning for further testing. [32]. Due to time constraints, this research has only been completed until the validity stage. The next stage of this research is a trial in schools to determine the level of effectiveness and practicality of the CPS-based e-module integrated 21st-century skills.

4. CONCLUSION

The CPS-based physics e-module integrated with 21st century skills has met the valid criteria: the content feasibility component is in the very valid category with a value of 93.18, the presentation component is in the very valid category with a value of 85, the graphic component is in the very valid category with a value of 85. the value of 95.45, and the language component is in the very valid category with a value of 83.33. The next stage of this research is the practicality and effectiveness test. So that this e-module is ready to used in learning in schools.

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