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E-Module Problem Solving Assisted by Virtual Home Lab Learning on Dynamic Electricity Material to Improve Understanding of Concepts

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ABSTRAK

Keterbatasan bahan ajar, alat serta media pembelajaran fisika yang interaktif. Keterbatasan tersebut tentu berpengaruh terhadap hasil belajar yang menyebabkan rendahnya pemahaman siswa terhadap materi yang dipelajarinya secara khusus materi listrik dinamis. Tujuan penelitian ini untuk menciptakan e-modul fisika berbasis problem solving dan berbantuan virtual lab rumah belajar pada materi listrik dinamis. Jenis penelitian ini adalah Research and Development (R&D) menggunakan model ADDIE. Subjek pada penelitian ini adalah 3 validator ahli, 2 orang guru dan 20 orang siswa pada uji coba praktikalitas. Instrumen penilaian yang digunakan yaitu instrumen berupa angket lembar validasi, dan lembar penilaian praktikalitas guru dan siswa. Teknik analisis data dalam penelitian ini adalah teknik analisis deskriptif kualitatif dan kuantitatif. Penelitian ini menghasilkan rata-rata skor validasi e-modul dalam kategori valid yaitu 3,57, dan hasil rata-rata skor praktikalitas e-modul termasuk kategori praktis yaitu 3,71 dan 3,67 oleh guru dan siswa. Hasil penelitian ini yaitu e-modul dapat dikategorikan valid dan praktis sehingga layak untuk digunakan dalam pembelajaran. Pengembangan e-modul berbasis problem solving Pada materi Listrik dinamis untuk meningkatkan pemahaman konsep siswa mencapai tujuan yang diharapkan. Implikasi penelitian ini yaitu e-modul yang dikembangkan dapat digunakan sebagai alternatif bahan ajar oleh guru dan siswa pada mata pelajaran Fisika di kelas IX SMP khususnya materi listrik dinamis.

ABSTRACT

Limited teaching materials, tools, and interactive physics learning media. These limitations certainly affect learning outcomes, causing students' low understanding of the material they study, specifically dynamic electricity. This research aims to create a physics e-module based on problem-solving and assisted by a virtual home learning lab on dynamic electrical materials. This type of research is Research and Development (R&D) using the ADDIE model. The subjects in this research were 3 expert validators, 2 teachers, and 20 students in practicality trials. The assessment instruments used are validation sheet questionnaires and teacher and student practicality assessment sheets. The data analysis techniques in this research are qualitative and quantitative descriptive analysis techniques. This research produced an average e-module validation score in the valid category, namely 3.57, and the average e-module practicality score in the practical category, namely 3.71 and 3.67, by teachers and students. The results of this research are that e-modules can be categorized as valid and practical, so they are suitable for use in learning. Development of e-modules based on problem-solving on dynamic electricity material to increase students' understanding of concepts to achieve the expected goals. This research implies that the e-module developed can be used as alternative teaching material by teachers and students in Physics subjects in class IX SMP, especially dynamic electricity material.

1. INTRODUCTION

Education is a series of learning that aims to enable students to understand, understand and develop their potential (Maison & Wahyuni, 2021; Nuha et al., 2021; Rosli et al., 2023). Seeing how important education is for a nation, it is necessary to improve the quality of education by improving the quality of learning (Setiadi & Zainul, 2019; Ulfa et al., 2021). One of the lessons that needs to be improved

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is physics. Physics is a material in science learning in junior high school and the material requires a relatively high level of understanding (Haqiqi & Sa'adah, 2018; Ismanto et al., 2022; Vitrianingsih et al., 2021). Physics is a branch of science subjects, which requires understanding, not memorization, in learning (Dudeliany et al., 2021; Karlina et al., 2021). Learning physics is often referred to as a difficult subject by junior high school/MTS students and the equivalent (Kallesta et al., 2018; Linda et al., 2021). This is because physics subjects are very abstract, making it difficult for students to understand the material, especially dynamic electricity material. Apart from that, most students do not understand physics concepts well but only memorize a lot of formulas.

In reality, the ability of students in Indonesia to study science related to character is still low (Mahfuddin & Wahyuni, 2021). Character strengthening can be given to students through information in the form of knowledge so that conclusions can be drawn that need more attention. The results of the initial needs analysis questionnaire for junior high school students in Pekanbaru showed that 50.5% of students found dynamic electricity material difficult. One of the obstacles that makes physics difficult to understand is the use of teaching materials, where teachers in schools still rely on textbooks. Package books are considered less effective in learning, where package books or texts (textual) are currently presented in printed form, and the appearance and illustrations are still less attractive so they are less attractive to students, as a result students find it difficult to understand concepts because they are boring (Fuadi et al., 2020; Hervi & Ristiono, 2021). Base on interview resultes with science teachers, it was found that the limited physics kits caused experiments in physics subjects in the school to be hampered, one of which was on dynamic electricity material, so that understanding of concepts in dynamic electricity material had not been fully achieved. This is related to one of the factors that do not carry out practicums in schools, namely the lack of laboratory equipment (Kallesta et al., 2018; Theasy et al., 2021).

The solution to help students' difficulties in learning science, especially physics, is by developing an Electronic Module (e-module). Learning objectives will be easier to achieve if you use interactive media in the form of electronic modules consisting of audio, video, animation and images (I. M Astra et al., 2020; Satria Dewi Pendit et al., 2022). The development of a good physics science e-module can provide benefits for teachers and students, where the existence of an e-module can help students to understand physics concepts well, and can help students relate physics learning to life (I Made Astra et al., 2020; Sofyan et al., 2020). Furthermore, teachers can use e-modules in learning to encourage students to learn independently, creatively and effectively (Wiratama & Margunyasa, 2021). Electronic modules can support students' independent learning process with a systematic arrangement. Presenting e-modules containing images, animation, video and audio can increase students' motivation to learn (Hervi & Ristiono, 2021; Lestari & Parmiti, 2020). Apart from that, the presence of e-modules can be used by teachers to present and explain material with new innovations that can motivate and increase students' understanding of concepts. The development of Physics e-modules can be developed using the problem solving method, which is considered effective for students in solving problems in learning, especially in dynamic electricity material (Br Hotang, 2019; Maryati, 2018). The problem solving method is a learning method that encourages students to solve problems in order to achieve teaching objectives (Aflaha, 2017; Sa'diah et al., 2019). The indicators of problem solving are understanding, analyzing, planning, implementing and evaluating a problem (Yuriev et al., 2017).

The problem solving method is an elaboration of problem-based learning with learning stages assisted by experimental activities. It is hoped that carrying out experiments can increase student motivation, understanding and skills. Experimental activities provide space for students to carry out and discover concepts for themselves according to learning objectives (Theasy et al., 2021). However, with various obstacles in implementing experimental activities, alternatives are needed to make it easier for students to carry out experiments. One way is by utilizing a virtual lab, namely Study House. Rumah Belajar is one of the virtual labs provided by the Ministry of Education and Culture and can be accessed via the internet and an Android application (Wilasari & Budiyanto, 2021). The Rumah Belajar portal plays an important role in the field of education, where the Rumah Belajar portal can make it easier for educators to develop innovative and interesting learning.Using a virtual laboratory with interesting animations can help students understand abstract scientific concepts (Rizaldi et al., 2020). Previous research findings stateTeaching materials using the Kvisoft Flipbook Maker application are suitable for use in the learning process (Maharcika et al., 2021; Wibowo & Pratiwi, 2018). The Social Sciences Subject Interactive E-Module is suitable and valid to use (Aryawan et al., 2018). The PBL (Problem Based Learning) based mathematics e-module on data presentation material is suitable for use by junior high school students (Ramadanti et al., 2021). The newest version of this physics e-module is an e-module based on problem solving and assisted by a virtual labhome learning on dynamic electricity material.The aim of this research is to create a physics e-module based on problem solving and assisted by a virtual home learning lab on dynamic electrical

material. There is hoped that the e-module can be used by teachers and students of Class IX Middle Schools in learning Physics and Science.

2. METHOD

This research uses Research and Development (R&D) research with the ADDIE development model. The ADDIE development model consists of 5 stages, however, research on the development of e-module learning media was only carried out in three stages, namely the Analysis, Design and Development stages. The Analysis Stage (Analyse) is a stage carried out to obtain initial information regarding product development needs, analysing the requirements carried out in the development procedure. This analysis stage is carried out in two stages, namely, the needs analysis stage and the task analysis stage. The design stage is the stage of determining the elements needed to be included in the e-module, including the e-module framework design stage, the learning scheme design in the e-module and the assessment instrument design stage. The e-module being developed then enters the development stage, namely carrying out validation and practicality tests. The aim of this development stage is to assess the validity and practicality of the e-module. At each stage of development, an evaluation is carried out as feedback and suggestions for improvement for the perfection of the e-module as a whole. The validation stage was carried out by 3 expert validators, then practicality trials were carried out by 2 teachers and 20 junior high school students. The students selected to carry out practicality trials were students who had previously studied dynamic electricity material, who were selected by the physics subject teacher based on the results of the learning level. Data collected used direct observation methods and questionnaires. Furthermore, the research instruments are in the form of questionnaires, namely e-module validation test questionnaires and teacher and student e-module practicality test questionnaires which are presented in Table 1, Table 2, and Table 3.

Table 1. Instruments E-Module Validation Assessment

No	Assessment Aspects	Assessment Indicators	Number of Assessment Items
1.	Content Eligibility	Material Coverage	3
		Material accuracy	3
		Up-to-date material	3
2.	Pedagogical Feasibility	The nature of problem solving	2
		Problem solving components	4
		Suitability of e-modules with aspects of understanding concepts	3
3.	Feasibility of Presentation	Presentation equipment	6
		Presentation support	2
		Presentation view	2
		Presentation Quality	4
		Effectiveness of presentation	2
4.	Linguistic Feasibility	Conformity to language rules	4
		Communicationof	3
		Interactive	1
5.	Graphic feasibility	Cover and content design	7
		Layout	2

(Herawati & Muhtadi, 2018; I Dewa Ayu Made Parimita Dewi & Gede Wira Bayu, 2022)

Table 2. Instruments E-Module Practicality Assessment by Teachers

Aspect	Indicator	Amount
Ease of Use	Use of e-modules	3
Attractiveness of the Dish	E-module design	5
Benefit	Benefits in learning	5
Material	Material in e-module	6

(Ernica & Hardeli, 2019; Fadhillah & Andromeda, 2020)

Table 3. E-Module Practicality Assessment Instrument by Students

Aspect	Indicator	Amount
Interest	E-module design and e-module content	7
Language	Readability and clarity of information in e-modules	4
Graphics	Use clear font type and size, layout, illustrations	3

(Ernica & Hardeli, 2019; Fadhillah & Andromeda, 2020)

Analysis method. The data used in this research is qualitative descriptive analysis and quantitative descriptive analysis. The qualitative descriptive analysis method is used to process data resulting from reviews carried out by learning material experts, namely physics subject experts, learning media experts and practitioners. The quantitative descriptive analysis method was used to describe the average score of each physics subject expert, learning media expert and practitioner related to the e-module media being developed.

3. RESULT AND DISCUSSION

Results

This research uses Research and Development (R&D) research with the ADDIE development model. The ADDIE development model consists of 5 stages, however, research on the development of e-module learning media was only carried out in three stages, namely the Analysis, Design and Development stages. The e-module developed is presented systematically and interactively with a combination of images, text, audio and video. The e-module development process goes through 5 stages according to the ADDIE development model. The questionnaire given to junior high school/MTS students in the Pekanbaru city area, aims to obtain information regarding the problems students face in learning as well as the solutions students need to face these problems. The results of the needs analysis carried out show that students are generally passive during the learning process. Students enjoy learning that actively involves them, such as conducting experiments. Students feel uninterested in learning if they only listen to the teacher's explanation, without involving their active participation. Students also feel happy if there are learning resources that can utilize Android or IT so that the learning materials are interactive. Then students also expect a learning process that makes them active in participating in learning activities. When distributing the needs analysis questionnaire there are also questionsThe material that students consider difficult is Dynamic Electricity which has many formulas. Apart from that, the limited tool kits in schools also make it difficult for students to understand dynamic electricity material.After passing through the needs analysis stage, it is continued with task analysis with two stages, first, analysis of the material and concept structure which includes core competencies, basic competencies, competency achievement indicators and a general overview of dynamic electrical material through a concept map. Next, the second analysis is the analysis of learning objectives, which includes analysis of the objectives to be achieved in learning which refer to the core competencies and learning syllabus, so that the e-module developed can be a solution to learning media needs.

The second stage is the design stage which includes creating an e-module framework design in the form of determining a scheme consisting of cover, e-module identity, foreword, table of contents, glossary, instructions for use, concept map, introduction, brief description of material, prerequisites. learning, objectives, indicators, material descriptions, experiments, example questions, practice questions, conclusions, group assignments, bibliography and back cover. After the initial design is determined, proceed with making it flow chart, storyboard determining the theme, layout and basic background of the appropriate e-module. Carry out a content search by collecting various supporting materials, such as images, videos, animations referring to high school and university physics book references. In the design stage, product assessment instruments were also created in the form of expert validation assessment instruments and practicality assessment instruments in the form of teacher and student response questionnaires. The design stage ends with an evaluation of the learning objectives. The third stage is the development stage, namely realizing the entire design based on flowcharts and storyboards which have been prepared into a real product in the form of an e-module according to the research objectives. The creation of the e-module was carried out using Microsoft Word first with the help of the Canva design application to add to the attractiveness of the e-module in terms of color, background, images and animation. After the e-module in doc format has been completed, proceed with converting the e-module to pdf format. This is done because the e-module editing process on the professional flip pdf platform can only be done in pdf format. Next, the e-module in PDF format is downloaded into a professional PDF flip which is then edited to add video, audio, trial links, question links and LKPD links. The physical form of the e-module is presented in Figure 2.

In the e-module development stage, a validity test of the e-module was carried out by 3 experts, here in after referred to as validators. The three validators provide an assessment in the form of numbers for each assessment indicator as well as comments and suggestions for improving the feasibility of the e-module being developed. The E-Module that was developed went through two stages of validation, where in stage 1 validation, there were still assessment indicators that needed to be improved according to the validator's suggestions. The e-module validation results are shown in Table 4.

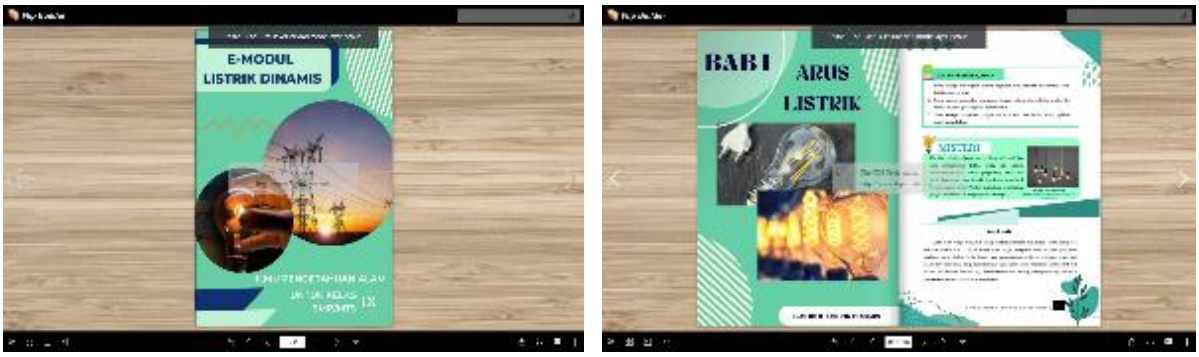

Figure 2. Sample of E-Module Development Results

Table 4. E-Module Validation Assessment Results

Feasibility Assessment Aspects	Stage 1		Stage 2	
	Average score	Note	Average score	Note
Contents	3.43	Valid	3.62	Valid
Pedagogy	3.55	Valid	3.62	Valid
Presentation	3.32	Valid	3.53	Valid
Language	3.32	Valid	3.48	Valid
Graphics	3.54	Valid	3.58	Valid

Table 4 shows that the average score obtained for each aspect of the assessment is valid, meaning that the physics e-module developed is valid and suitable for testing on students. E-modules that have been declared valid by the validator can be continued with practicality tests using small group tests on teachers and students. The aim of the practicality test is to see whether the dynamic electrical e-module as a whole is practical and feasible to implement in learning. Participants involved in this practicality test were 2 Physics Science teachers and 20 students from SMP 42 Pekanbaru. The practicality assessment is presented in Table 5.

Table 5. Results Evaluation Practicality E-Module by Teacher

No	Indicator Evaluation	Average score -flat	Category
1.	Ease of use	3.83	Practical
2.	Independence of serving	3.80	Practical
3.	Benefit	3.60	Practical
4.	Material	3.60	Practical
Average		**3.71**	**Practical**

Table 5 shows the average score for all aspects of the practicality test results by 2 teachers of 3.71, including the practical category. Next, data on the results of the trial assessment via student response questionnaires practical category, meaning e-modules are practical if used as a science learning medium in schools. Data on the results of practicality assessments by students are presented in Table 6.

Table 6. Results of E-Module Practicality Assessment by Students

No	Assessment Indicators	Average score	Category
1.	Interest	3.63	Practical
2.	Language	3.73	Practical
3.	Graphics	3.67	Practical
Average		**3.67**	**Practical**

Based on Table 6 the average score for the overall aspect of practicality results for 20 students was 3.67, including the practical category, meaning that overall, based on the practicality assessment of the e-module by teachers and students, it is practical and suitable for use in physics learning, especially dynamic electrical meter class Xl with The aim is to increase understanding of the concept. At the development stage, evaluation is also carried out. Evaluation at this stage is carried out based on suggestions for improvement from the validator during validation, and also suggestions for improvement from teachers and students during the practicality process.

Discussion

The development that has been carried out has resulted in a product in the educational sector in the form of a dynamic electrical physics e-module based on problem solving with the help of the virtual learning house lab. The development of this e-module is generally to help teachers and students in the learning process. In particular, the development of this e-module for teachers can become one of the physics teaching materials, especially dynamic electricity material for class Xl with learning stages based on a problem solving approach and adapted to student needs, namely to support understanding of concepts. Students' low understanding of concepts can cause students to have difficulty accepting new knowledge taught to them.Students' low understanding of concepts will certainly have a negative impact on the students themselves, because it can make it difficult for students to learn the next material (Radiusman, 2015; Riwanto et al., 2019). The aim of developing this e-module specifically for students is that it can become learning material that can be used both at school and as independent learning material. Technology-based e-Modules are an effort to utilize technology optimally which will have an impact on convenience in the field of education (Asrial et al., 2020; I. M Astra et al., 2020; Halidjah & Pranata, 2021). Interactive e-modules can train students' five senses optimally, because using e-modules in learning not only trains the sense of hearing, but also involves the sense of sight. In receiving information, if humans optimize all their five senses, it is likely that the information will be easy to remember and understand (Junaidi, 2019). Apart from that, the e-module being developed is assisted by the use of a virtual home learning lab which aims tocan help students become skilled in learning. The use of virtual experiments, one of which is the home learning portal, can improve students' concept understanding skills (Wicaksono et al., 2020).

The content feasibility aspect focuses on the material presented in the e-module in terms of coverage, accuracy and up-to-date material. The pedagogical aspect focuses on the completeness of the material which refers to a problem solving approach so that it can increase students' understanding of concepts. The material in physics learning is continuous material, therefore if students do not understand the physics material being studied, it will be difficult for students to understand the next material (Rizkita & Mufit, 2022; Widaningrum et al., 2020). Furthermore, the feasibility aspect of presentation focuses on the completeness of the e-module presented in terms of completeness, support, appearance, quality and effectiveness of presentation. The language appropriateness aspect focuses on conformity with PUEBI rules, the use of communicative and interactive language in conveying learning material. The graphic feasibility aspect focuses on the appearance of the e-module itself, in terms of design, color, writing and layout, the e-module can stated valid. Valid criteria indicate that the essential truths in the e-module can be fulfilled very well (Ariana et al., 2020; Baharuddin et al., 2020). Making an e-module with constituent parts that match the indicators of the validation instrument can produce a valid e-module (Mijaya et al., 2021). Furthermore, this electronic module can be used as an independent learning resource, helping students learn material more effectively, and improving their abilities and knowledge (Komikesari et al., 2020).

Judging from the validation results of the feasibility of the e-module content, it shows that the e-module is in the valid category. Quality modules can improve students' skills in terms of the appropriateness of the content in the form of the accuracy of the material presented. The E-module has facilitated students in practicing problem solving based learning. Problem solving can train students to search, find and solve problems in learning in order to achieve learning goals (Rohim & Umam, 2019; Wahyuni et al., 2020; Yuriev et al., 2017). A problem solving based learning approach is suitable when applied in science learning (Sa'diah et al., 2019). The e-module developed must be able to train students to reconstruct knowledge and skills with various activities presented in each meeting (Laili et al., 2019).

The linguistic feasibility aspect of the e-module obtained results in the valid category. Valid criteria in the linguistic aspect indicate that the delivery of simple language makes it easy for students to understand, and gives the impression that students can communicate directly with the e-module. The linguistic component is related to the use of sentencesThe module must be clear and unambiguous so that it is easy for students to understand (Hasanah et al., 2023; Jambi, 2019). E-modules must be communicative to increase enthusiasm and encourage student activity in carrying out the learning process (Wilasari & Budiyanto, 2021). The graphic feasibility aspect of the e-module obtained results in a very high category so that it could be declared valid. These valid criteria show that the type and size of text used in the module makes it easier for readers. Apart from that, the module developed already has good graphic elements with matching images, colors and letters. The layout of the module is pleasing to the eye and the cover design is appropriate to describe the contents of the e-module. A good electronic module must be prepared systematically so that it can achieve self-instructional criteria, namely clear learning objectives, including illustrations, examples and using language that supports the clarity of the material (Fadhillah & Andromeda, 2020; Lange & Costley, 2020). The attractive appearance of the e-module from a visual perspective can be seen from the different structures and animation displays so that it attracts interest in learning (Hervi & Ristiono, 2021;Perdana et al., 2017). The use of e-modules can help teachers provide learning without

limitations of space and time in the classroom in the learning process (Rahmadhani et al., 2021). It is hoped that the ease of use of this electronic module can help students learn new knowledge and continue to practice their skills. Apart from that, integrated problem solving e-modules can be a new innovation in learning that is adapted to curriculum developments (I. M Astra et al., 2020; Br Hotang, 2019).

This finding is strengthened by previous research findings stating that the professional flip PDF application used for electronic teaching materials received a valid assessment (Komikesari et al., 2020; Sriwahyuni et al., 2019). Teaching materials using the Kvisoft flipbook maker application are suitable for use in the learning process (Maharcika et al., 2021; Wibowo & Pratiwi, 2018).The Social Sciences Subject Interactive E-Module is suitable and valid to use (Aryawan et al., 2018). The PBL (Problem Based Learning) based mathematics e-module on data presentation material is suitable for use by junior high school students (Ramadanti et al., 2021). The e-module development carried out is only limited to developing teaching materials in the form of e-modules on dynamic electricity material. As a recommendation, the e-module that has been developed can be continued with effectiveness testing in schools to see the effect of using e-modules in learning. Apart from that, the development of this e-module can be developed on other physics materials. The implication of this research is that the e-module developed can be used as an alternative teaching material by teachers and students in Physics subjects in class IX SMP, especially dynamic electricity material.

4. CONCLUSION

The e-module has been successfully developed through validation and practicality test results by teachers and students. Physics e-modules based on problem solving assisted by virtual home learning labs to improve understanding of concepts can be declared valid and practical, so they are suitable for application in physics learning, especially dynamic electricity material.

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