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Inquiry-Based Phase Change E-Module For Third Class Students

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ABSTRAK

Penelitian ini dilatarbelakangi oleh penggunaan bahan ajar berupa LKS, materi disajikan kurang menarik sehingga belum bisa tepat waktu selama proses belajar. Hal ini berpengaruh terhadap kemampuan siswa untuk berpikir kritis memecahkan permasalahan materi perubahan wujud. Penelitian ini bertujuan untuk mengembangkan e-modul perubahan wujud berbasis inkuiri untuk siswa kelas 3 SD. Subyek penelitian terdapat 10 siswa kelas 3 Sekolah Dasar. Metode penelitian pengembangan dengan model 4D meliputi Define, Design, Develop, dan Dessiminate. Instrumen yang digunakan dalam penelitian ini adalah lembar angket. Analisis data yang digunakan berupa teknik analisis data kuantitatif dan kualitatif melalui validator ahli media dan materi serta angket respon guru dan siswa. Hasil penelitian menunjukkan bahwa e-modul perubahan wujud berbasis inkuiri dinyatakan layak atau valid dengan skor rata-rata 94,16% (Ahli media) dan 82,36% (Ahli materi). Penggunaan e-modul melalui angket respon guru 92,75% dan siswa 84,79% dinyatakan sangat praktis. Oleh karena itu, berpengaruh pada kognitif siswa dalam memahami materi perubahan wujud dengan nilai rata-rata 81. Sehingga e-modul perubahan wujud berbasis inkuiri dapat membantu siswa dalam meningkatkan kemampuan kontekstual siswa menumbuhkan sikap kognitif dan mandiri siswa.

ABSTRACT

This research is motivated by the use of teaching materials in the form of worksheets, the material presented is less attractive so that it cannot be on time during the learning process. This affects the ability of students to think critically to solve material problems of change of form. This study aims to develop an inquiry-based e-module of transformation for grade 3 elementary school students. The subjects of the study were 10 grade 3 elementary school students. Development research methods using 4D models include Define, Design, Develop, and Disseminate. Intrument used in this study is questionnaire sheets. The data analysis used quantitative and qualitative techniques through media and material expert validators and teacher and student response questionnaires. The results showed that the inquiry-based phase change e-module was declared feasible or valid with an average score of 94.16% (Media Expert) and 82.36% (Material Expert). The use of e-modules through a questionnaire response of 92.75% of teachers and 84.79% of students was efficient. Therefore, it influences students' understanding of phase change material with an average value of 81. So that inquiry-based phase change e-modules can help students improve students contextual abilities foster students' cognitive and independent attitudes.

1. INTRODUCTION

In the modern era, the learning process has many technological advances. Developments in the era of globalization are changing education that is increasingly advanced to realize modern learning. Modern learning can provide innovation as an information system for aspects of life and educational research (Hsieh, 2020; Tang, 2021). In Indonesia, the current covid-19 outbreak has hampered learning in schools. To prevent the spread of COVID-19, the government urges the public to avoid gathering or group events; the solution for learning during the current pandemic is online learning (Rigianti, 2020; Sadikin & Hamidah, 2020). Technology delivers online learning, especially on the internet. Learning activities carried out by educators in the classroom were able to influence the mindset and development of

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students, especially in the development of students in learning (Asrial et al., 2020; Pebriana, 2017). Technology development is one of the highlighted aspects of education, effective by providing knowledge that supports student learning. Teachers use the 2013 curriculum to support learning activities in Indonesia. The 2013 curriculum has been well designed and combines several subjects that combine several discussion materials to achieve learning in the classroom (Altinyelken, 2010; Nasrul, 2018). Thematic learning links several materials and student experiences in learning to balance the material. In learning activities, the teacher hopes teachers can develop teaching materials to make it easier and make students independent in learning (Apriyanti, 2017; Nugraha et al., 2013). In addition, thematic learning will be successful if educators can understand lesson planning well, thus before the learning process, teachers should design learning first.

Based on observations at school, students' thematic learning only uses worksheets and textbooks from schools. In learning activities, students still have difficulty participating in learning. The material taught by the teacher is not exciting, and it is difficult to understand the material, which results in the wrong time as planned by the teacher. In addition, the teacher does not formulate learning strategies that can meet students' cognitive needs in learning activities. So that thematic learning seems to be not confusing for students (Diputra, 2016; Tinja et al., 2017). The COVID-19 pandemic period, which has now reached level three, has affected the learning stage for students to study at home, or called online learning. Students and teachers need innovative learning tools that they can access independently. So that parents do not have to accompany them. Entirely, train students in disciplines, eliminate laziness to study online. Thematic learning is integrated learning that uses themes to link several subjects to provide student experiences. As technology advances, the teacher must remember to improve, making teaching materials more interesting (Rachmadtulla et al., 2019; Wulandari et al., 2020). So, it is necessary to have independent teaching materials in e-modules as independent teaching materials. With the facts in the field based on observations at schools with various problems faced, especially during the pandemic, so to overcome these problems it is necessary to have independent teaching materials in the form of e-modules as independent teaching materials through an inquiry approach. E-module is a non-printed teaching material product that contains material. Teachers and students can use it in their thematic learning (Kuncahyono, 2018; Rahmatsyah & Dwiningsih, 2021). According previous study e-module is a very appropriate tool as a learning resource with various advantages in packaging materials, images, videos, and using the internet to access them (Solihudin JH, 2018). So that through e-modules, students can understand the material and solve the learning problems they learn (Mishra et al., 2017; Rilianti, 2019).

Inquiry-based learning facilitates students to learn and seek information from various sources. E-modules can explore behavior, are faster in use, have a positive effect so that there is a relationship between reader scores and reading behavior patterns (Hotchkiss et al., 2015; Zarzour et al., 2020). In obtaining a thematic understanding, the teacher designs a well-designed learning strategy using an inquiry strategy. Inquiry is a strategy that emphasizes the process of thinking critically and analytically, finding and solving their answers to a question in question (Akhlis & Dewi, 2014; Hamdani & Islam, 2019). Educators use learning strategies that affect students' seeking and discovering new knowledge. Inquiry learning can improve student learning achievement in the classroom (Margunayasa et al., 2019; Rositawati, 2018). Inquiry learning is essential to attract students' attention, involving all students and teachers in learning activities; this activity involves activeness, realism, experience, and meaning in critical thinking through building problem solutions (Kandil & Işıksal-Bostan, 2019; Segal et al., 2018). The inquiry can provide explanations and justifications accompanied by concrete evidence. Inquiry, a student-centered pedagogical learning system, involves students learning mathematics. Student feedback in applying inquiry received a good response and enthusiastically participated in the learning (Hotchkiss et al., 2015; Pudwell, 2017). In addition, the inquiry strategy provides solutions and fosters a spirit of learning so that learning in the phase change material in the learning process achieves the expected goals.

Several previous studies have developed e-module teaching materials, namely developing scientific literacy-based e-modules for animal and human movement organs for fifth-grade elementary schools (Atmaji & Maryani, 2019). Furthermore, teaching materials for developing the-mathematical-based e-modules to improve problem-solving abilities (Utami et al., 2018). The following study developed an e-module with a realistic mathematics education approach for elementary school students with geometry material (Buchori & Rahmawati, 2017). Based on this research, it is essential to develop an inquiry-based phase change e-module. The importance of this research is the researchers developed an inquiry-based e-module of transformation. The purpose of the study was to develop the feasibility, practicality and effectiveness of developing an inquiry-based e-module of material change material for grade 3 elementary school students.

2. METHOD

This study uses a 4D model (four D model), including Define, Design, Develop, and Disseminate. The researchers chose the 4D model because the e-module was developed and arranged in a systematic, detailed, and coherent manner to facilitate researchers in developing e-module products. Defining activities aims to obtain data on the needs of researchers by observing and interviewing third-grade guardians in elementary schools. Planning is making an initial product plan consisting of material, questions, and learning assignments according to the researchers' references. Development is conducting a feasibility test of the product developed by providing an assessment questionnaire conducted by two lecturers, material experts, and media experts. In addition, at this stage, also make product improvements by suggestions and input from expert lecturers. A module is valid if developed is based on the module development procedure and validated by experts (Faroh et al., 2018; Sugiyono, 2016).

The subject of the study was conducted by the homeroom teacher of grade 3 and the students were 10 students of grade 3 Elementary School. Types of data, how data is collected, with instruments where data is collected, and how technical the collection is, should be explained clearly in this section. Then, how to interpret the data obtained, in relation to problems and research objectives, needs to be explained clearly. Distributing or distributing the product practicality test by filling out a questionnaire by the third-grade homeroom teacher and small groups of 10 third-grade students. Finally, at this dissemination stage, the researchers also tested the product's effectiveness by testing the effectiveness of e-learning modules in teaching and learning activities in school. The research uses and data analysis techniques are show in the Table 1.

Table 1. Data Analysis Techniques

Quantitative	Qualitative
Quantitative analysis uses score scores and validation results from the product feasibility test of the inquiry-based phase change e-module product development	Qualitative data is data in the form of a questionnaire of procedures for developing e-modules, suggestions, and validator input.

The research instruments include e-module validation questionnaire sheets, teacher and student response questionnaires, and learning outcomes tests to measure students' ability in learning. By conducting tests on students, they can develop students' potential optimally and measure students' abilities so that teachers can modify learning (Maba, 2017). In this part, research sample need to be clearly explained in this section. It is also necessary to write down techniques for obtaining subjects (qualitative research) and/or sampling techniques (quantitative research). Procedure should be described according to the type of research. How research is carried out and data obtained, needs to be described in this section. For experimental research, the type of design (experimental design) used should be written in this section.

The research instrument grid for validator questionnaires is in the form of material/content (concept correctness, material flexibility), complete material in accordance with basic competencies presentation (matter instructions, color, material alignment according to contextual), language (sentence structure, easy-to-understand language) and graphic (layout, neat writing, precise font for easy reading). The teacher's response questionnaire instrument grid is in the form of appearance (attractive presentation, generates interest related to the material, position of the image according to the material), material/content (Contextual, achieves learning objectives, helps achieve concepts) and Language (communicative language, clear sentence structure).

3. RESULT AND DISCUSSION

Result

The researcher conducted a feasibility test practicality test and tested the effectiveness of the inquiry-based cube-based e-module. Then, validators, namely media experts and material experts, perform the advisability to assess the questionnaire and produce a draft e-module. The feasibility assessment carried out by media expert validators, and teaching materials are in Table 2. Based on Table 2 show the validation provided by the validator, the validation of e-module teaching materials reached 94.16%, with a correct category. Analysis of the material contained in the inquiry-based e-module found in the validation results of the material expert, the data obtained in the form of the value of determining the level of validation from the inquiry-based phase change e-module material expert. The results of the validation of material experts and their categories are in Table 3.

Table 2. Results of Expert Validation of E-module Teaching Materials

No	Aspect assessed	Validity Level	Category
1	Graphic	92.5 %	very valid
2	Presentation	90.00 %	very valid
3	Languages	100 %	very valid
	Average	**94.16 %**	very valid

Table 3. Material Expert Validation Results

No	Aspect assessed	Validity Level	Category
1.	Material/content	80.55 %	valid
2.	Presentation	81.25 %	very valid
3.	Language	83.33 %	very valid
	Average	**82.36 %**	very valid

Based on Table 3, the level of validity of the inquiry-based phase change e-module from the three aspects, the average percentage of 82.36%, is categorized as very valid. The results of the assessment of the student and teacher response questionnaires are in Table 4 and Table 5.

Table 4. Percentage of Teacher Responses to Inquiry-Based Phase Change E-modules

No	Aspect assessed	Validity Level	Category
1	Appearance	92.85 %	Very effective
2	Contents	91.66 %	Very effective
3	Language	93.75 %	Very effective
	Average	**92.75 %**	Very effective

Table 5. Results of the Percentage of Student Responses to the Inquiry-Based E-Module Phase Change

No	Aspect assessed	Validity Level	Category
1	Appearance	85.62 %	Very effective
2	Material	86.25 %	Very effective
3	Language	82.50 %	Very effective
	Average	**84.79 %**	Very effective

Based on the results of the practicality assessment in Tables 4 and Table 5, the practicality of the inquiry-based phase change e-module gets a percentage of the number of teacher response questionnaires with an average of 92.75% efficient interpretation and the number of student response questionnaires an average of 84.79% very high interpretation. It is possible to analyze student learning outcomes to determine the effectiveness of the inquiry-based phase change e-module. In the analysis of student learning outcomes tests obtained from the average student learning outcomes, which reached a score of 81, test analysis is a way of analyzing quantitatively by determining the average test score from the sum of the scores of 10 students.

Discussion

Developing an inquiry-based phase changes e-module for third-grade elementary school students using a 4D model. That is consisting of the first four stages Define, the second stage designs, the third stage is Develop, and the last is Disseminate (Arthur et al., 2020; Purnamawati et al., 2017). The first is the Define stage, which relates to analyzing student responses and students asked through interviews while studying in class. The student analysis identifies students' basic abilities in thematic learning and the level of cognitive development associated with inquiry learning strategies. According to previous study the ability to think critically is one of the higher-order thinking processes that can grow students' abilities in learning (Purnamawati et al., 2017). Analysis of material that is considered difficult for thematic learning related to daily life to be done by students requires an inquiry-based e-module teaching material not to feel difficult, which is in detail and systematically.

The second stage of the design stage is the preparation of e-modules from instructions for using e-modules, phase change materials, plus the assignment of practice questions from the material, exam questions, evaluation questions, and assessments of the learning that students have done. Researchers' research design of teaching materials determines student improvement in learning (Asrial et al., 2020;

Rodiyana, 2015). The design of teaching materials aims to encourage students to actively think critically in the learning process that educators have delivered. Teaching materials are equipped with attractive pictures and colorful writing to make students interested and enthusiastic about learning can develop skills and evaluate (Carolina, Hifni Septina; Dewi, Asih Fitriana; Sari, Tika Mayang; Alpiah; Hakim, 2020). Following the concept of learning that students learn through direct and authentic experience connecting lessons, teachers are components in schools that occupy essential professions such as education (Maryani & Martaningsih, 2017; Nasrul, 2018).

In making e-module teaching materials, the learning management system must remain connected to the system so that researchers can add content to the e-module. The exelearning application makes it easy for students to learn and is very interesting. This application makes it possible to include animated images, materials, and quizzes to improve learning. In making the e-module in a web form using the exelearning application, the researcher added some exciting features and animated images to understand the material and independently answer the questions provided in the e-module. In addition, e-module learning through the exelearning application can be used remotely, such as teacher-student learning carried out outside the school environment (Azizah et al., 2017; Silalahi, 2020). Thus students can think critically and analytically to seek and find answers to a question independently.

From the research results the validation results from teaching materials experts obtained an average of 94.16% and material experts obtained an average of 82.36% which stated that they were valid. This is in accordance with previous research found from the validation of the material showing that it is valid with an average percentage of 82% and teaching materials experts get a percentage of 82% with valid criteria in developing e-modules in thematic learning (Kuncahyono, 2018). Then base on result practicality test of the teacher's response obtained results of 92.75% and student responses yielded 84.79% with very effective criteria. The practicality results are very practical and interesting e-modules in accordance with previous research developing e-modules based on scientific literacy material for animal and human limbs showed teacher and student responses with interesting categories for the learning process (Atmaji & Maryani, 2019). In addition, e-module teaching materials can improve critical thinking skills and can increase student learning motivation. An educator must have the ability not only from the setting but also from technology with the changing times that are increasingly advanced (Kurniawati, 2020; Perdana et al., 2017). It means that inquiry-based learning of the source phase energy for third-grade elementary school students has met the effectiveness. The criteria bse on previous study stated the effectiveness test from the evaluation, and student tests showed an average of 86.5%, with very effective criteria for developing e-modules (Kuncahyono, 2018). Based on student learning outcomes obtained from the average student learning outcomes which reached a value of 81. Student learning tests have proven that the inquiry-based e-module effectiveness test has been successful.

Research results from previous study found e-modules have the characteristics or context needed in the learning method to think innovation in the life around them to create creative learning centered on student activities (Lin, 2012). With the e-module, students will easily understand accurately and generate a positive response (Abidin, 2020; Deshmukh et al., 2019). In addition, the benefits of e-modules are that they can read or access wherever we are. There is audio to listen to independently, although, without audio, students will still learn to read independently (Dore et al., 2018; Lee et al., 2019). Electronic modules can educate students and raise good awareness of reading them. The inquiry has a significant value and has a high creativity effect on learning activities. Inquiry learning obtains impressive results in the investigation results as a scientific discipline and the application, discovery, and discussion of implementing a well-designed curriculum (Chang et al., 2015; Siagian & Nurfitriyanti, 2015). The appreciative inquiry aims to determine benefits while forming a future-focused foundation in introducing each individual and developing the community. Students in doing the task each process (Alameddine & Ahwal, 2016; Tosati et al., 2015). Inquiry investigation has emerged as a more fluent and effective means of communication; critical thinking skills will be increasing.

Based on the criteria and quality of the inquiry-based phase change, the e-module for Grade three Elementary School has met the eligibility criteria for e-module, namely validation test, practical test, and effectiveness test (Akhlis & Dewi, 2014; Nasrul, 2018). The energy source phase change e-module as a student companion book. Thus, inquiry-based phase change e-modules for third-grade elementary school students can improve critical thinking skills and grow and develop problem solutions in learning activities. Based on the criteria and quality of the e-module, the change in form has been based on inquiry for grade III Elementary School, it has met the eligibility criteria for the e-module, namely validation test, practical test, and effectiveness test (Nasrul, 2018; Perdana et al., 2017). The advantage of the research is that researchers can find out the use of e-modules in learning, have benefits in the world of education, help teachers in online learning and keep up with technological developments. Contribution of research results as a reference and further research development adds new knowledge in research Implications of

e-modules can be used as educational media during a pandemic. The e-module for changing the form of energy sources can be used as a student companion book. Thus, the inquiry-based e-module of transformation for grade 3 elementary school students can improve critical thinking skills and grow and develop problem solutions in learning activities.

The implication of this research is to provide overview of a positive impact on the use of e-modules at various elementary school levels in Indonesia by presenting an inquiry-based approach so that critical thinking students can connect with concrete events. Form the character of independent and tough students and Indonesian teachers can use e-modules in learning activities. online or offline so that learning activities are more fun, train students to provide problem solutions and be innovative. The limitation of this research is that research is still being developed by one school and one level of education so that further research can develop e-module research with various materials other than natural science subjects and can be developed between various schools in Indonesia to be used as samples and various levels of education.

4. CONCLUSION

Based on the results of the development of the inquiry-based phase change e-module, the inquiry-based phase change e-module for Class three was declared feasible, practical, and effective. The researcher hopes that the results of the development of electronic module teaching materials and inquiry-based phase change e-modules can be used during a pandemic to grow self-motivation and enthusiasm for learning to improve abilities. Students will also relate mathematics, especially phase change material, with pedagogical competence or train students to formulate hypotheses to reach conclusions. In addition, it can create a mindset so that students can think critically in formulating a problem and finding solutions. Further research can continue with e-module display with more interesting material and create a critical mindset in finding and building solutions, planting more detailed concepts to produce updates in developing teaching materials as sustainable research.

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