Electronic Module Development Based Scaffolding on Static Electricity

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Abstract. Research and development (R&D) has been carried out which has produced a scaffolding based e-module on Static Electricity. The purpose of this study is to describe the characteristics of the scaffolding-based physics e-module and to find out the student's response to the e-module which was developed to introduce high school students' critical thinking skills in the subject of static electricity. This study uses a 4D namely define, design, develop and disseminate. The define stage consists of compiling the instruments at the define stage, lesson plan analysis, analysis of learning tools and needs analysis. The design stage in this research consists of designing the module and designing the module evaluation instrument. The develop stage consists of expert validation and student response testing. The results of expert validation that have been carried out show that the e-module developed is in the very valid category with a validity value of 86% and students' responses to the e-module are in the very good category with a value of 82.1%. The characteristics of e-module include: the module links the subject matter with the Scaffolding aspect and displays the critical thinking aspect so that students are motivated to think at higher levels.

Keywords: E-module · Scafolding · Static electricity

1 Introduction

Awareness of the importance of education for every citizen encourages various efforts and attention from the government, society, and education implementers themselves on the development of education, especially on the use of technology and information in the world of education. Science that uses technology in the Globalization Era as it is today is always experiencing developments marked by the rapid use of technology and information, where the learning process at this time has shifted towards an effort to create a more modern learning [1]. The use of learning technology follows the times, one of the uses of technological developments in the world of education is to combine technological tools in the learning process [2].

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Teaching materials have a very important role for both teachers and students, for teachers the role of teaching materials is to save teaching time, make teachers a facilitator in learning and improve learning to be effective and interactive. As for students, teaching materials have a role that in general emphasizes so that they are able to playing an active role in learning and so that they can learn independently such as learning without being too dependent on others, learning anytime without being tied to the determination of time, determining the place to study, learning, the selection of the order of the material to be studied so that it is able to encourage students to become independent learners [3].

The development of teaching materials has several benefits, both benefits for educators and for students. The benefits of developing teaching materials for educators include: (a) the teaching materials developed can be adapted to the demands of the curriculum and the needs of students; (b) the problem of fulfilling textbooks which are often difficult to obtain can be overcome; (c) teaching materials have more broad meaning because they are developed using various references; (d) educators are able to increase the knowledge and experience of teachers in writing teaching materials [4]. From the explanation above, we can conclude that good teaching materials are able to make good learning outcomes as well. E-module is one example of good teaching materials and is often used by teachers to facilitate the learning process, because it is equipped with procedures for its use and contains videos, materials, practicum, and practice questions.

Electronic modules or e-modules are learning resources for students other than teachers that are designed systematically according to the rules with the aim of increasing effectiveness, efficiency, and increasing student interest in continuing to learn [5]. E-module is a set of digital or non-printed teaching media that is arranged systematically for independent study purposes [6]. E-modules are ICT-based products that have advantages compared to print modules, including their interactive nature which makes navigation easier, allows displaying/loading of images, audio, video and animation and is equipped with formative tests that allow immediate automatic feedback [7].

Based on the results of observations that have been carried out at STATE HIGH SCHOOL 8, STATE HIGH SCHOOL 7, and STATE HIGH SCHOOL 2 in Bengkulu City, it was found that they had used the 2013 curriculum, but in practice the learning process carried out using the online method had not facilitated active interaction between teachers and students so that students did not actively involved in the learning process. The teaching materials used are in the printed books. The use of e-modules in learning is also still minimal. Physics learning has been quite good but in the learning process it is still lacking in improving critical thinking skills. This is reflected in learning that has not raised questions that invite students to think critically. Moreover, students consider physics as a difficult subject, especially the material for static electricity. Materials or media for learning used by educators so far have not been maximized in making students think critically and interested in studying physics. Students said that they needed learning media to help them understand the Static Electricity material better.

Critical thinking is a life skill and a hobby that can be developed by everyone, therefore this hobby should be developed in elementary, junior high and high school [8]. Critical thinking ability is not an ability that can develop by itself along with human physical development, critical thinking skills must be trained through the provision of stimuli that require someone to think critically [9]. In this study, the stimulus was given

using scaffolding. Scaffolding was in the form of guiding questions and assistance that would help students build knowledge and finally students could answer questions that contained critical thinking indicators.

Scaffolding means providing a large amount of help to a child during the early stages of learning then the child takes on increasing responsibility as soon as he is able to do so [10]. Scaffolding is an approach as a learning strategy that provides assistance (scaffold) to students in a structured way in solving the problems given so that students better understand the lesson [11]. The application of scaffolding has been applied in several studies, including scaffolding to train concept understanding [12]. Scaffolding in module development [13]. Scaffolding in the development of teaching materials [14] and Scaffolding to train critical thinking [15].

Scaffolding-based E-Module with critical thinking orientation is expected to help students understand physics lessons, especially Static Electricity material. The e-module developed does not only contain material, scaffolding and critical thinking aspects are one of the contents contained in the e-module. The combination of scaffolding and practicum activities as outlined in the students' E-modules is expected to help students become more independent and active in the learning process. Based on the previous description, the formulation of this research is (1) How are the characteristics of Scaffolding-based E-modules with critical thinking orientation that have been developed on Static Electricity material in high school. (2) How do students respond to the e-module that has been developed.

2 Method

This research is included in the classification of research and development (Research and Development/R&D) which uses the 4 D model development model. According to Trianto in Hera and Khairil [16] suggests research and development steps consist of define, design, development and dissemination. The product produced is teaching materials in the form of scaffolding-based physics e-modules oriented to critical thinking on static electricity materials in high school that are valid.

This research has been carried out at the Faculty of Teacher Training and Education, Bengkulu University and STATE HIGH SCHOOL 7, STATE HIGH SCHOOL 8 and SMA 2 Bengkulu City in 2020 to 2021. The subjects used in this study were class XII students in each school, namely STATE HIGH SCHOOL 7, STATE HIGH SCHOOL 8 and STATE HIGH SCHOOL 2 in Bengkulu City. Data collection techniques in this study were carried out in several ways: 1) observation sheets, 2) student needs analysis questionnaires, 3) teacher needs analysis questionnaires, and 4) LESSON PLAN document review sheets and module document reviews used in schools. Data collection technique is a way to collect data or information to find out the potential of what kind of product needs to be developed according to the level of need and potential problems. The instruments used in this study were 1) Expert and practitioner validation questionnaires, 2) student response questionnaires and 3) E-module characteristic review sheets) to determine the characteristics of the developed e-module.

The data analysis technique used in this research and development is a qualitative and quantitative descriptive analysis technique with the percentage method. The assessment of the feasibility of the Scaffolding-based electronic module was carried out using

quantitative data obtained from questionnaire assessments by material and media experts as well as student responses. The data analysis technique to obtain quantitative data uses a Likert scale as a measurement scale. The Likert scale used is arranged in the form of a statement and is followed by four responses.

3 Result and Discussion

The first step in this research is the define stage. The define stage in this research consists of compiling instruments for the define stage according to the information needs needed for the define stage. In this study, to find out how the learning process takes place in schools and to analyze the need for the development of a new teaching material, it is done by interviewing physics teachers at three schools in the city of Bengkulu, namely STATE HIGH SCHOOL 8, STATE HIGH SCHOOL 7 and STATE HIGH SCHOOL 2 in Bengkulu City. Where the interview results obtained are the curriculum used at the school is the 2013 curriculum. Where the 2013 curriculum used requires students to be active in the learning process, so the teacher must create a learning atmosphere that allows students to be more active during the learning process, one of which is that is by making interesting teaching materials so as to create a learning attraction for students.

To support the teacher interview data that has been carried out, the researchers took questionnaire data to analyze whether the product to be developed was really needed by students and teachers or not in the learning process at school. After finding the problem, then a literature study is carried out to collect supporting data as material for the development of new teaching materials.

To obtain supporting data as a basis for development, an analysis of the learning implementation plan and learning tools is carried out. The results showed that the lesson plans used at STATE HIGH SCHOOL 8 Bengkulu City were in accordance with the 2013 curriculum. The learning tools analyzed were e-modules enough to train students' critical thinking skills.

The needs analysis that has been carried out aims to collect information on the product to be developed, because the product developed is in the form of a scaffolding-based e-module, it is hoped that there will be an increase in the quality of physics learning in the classroom. In addition, this scaffolding-based e-module is oriented towards students' critical thinking skills.

In the next stage, after the define stage, it is continued with the design stage. This stage is the initial stage to develop Scaffolding-based e-modules oriented to critical thinking on Static Electricity material in high school. This stage begins with compiling learning tools, choosing the media to be used, designing materials and designing the initial design of the e-module that will be developed. The design of the module consists of 3 parts, namely the beginning or cover, the core or content and the end or closing. The first part of the e-module contains the cover or cover, foreword and table of contents. The content or core section of the module contains core competence, basic competencies, indicators, learning objectives, material descriptions, activities and competency tests in which scaffolding aspects and critical thinking indicators are raised. The closing section of the module contains a bibliography and a glossary.

After carrying out the design stage for the development of the scaffolding-based e-module that was developed, the next stage is the develop stage. At this stage, the validity

test was carried out by 3 experts and revised based on the results of the validation. This stage aims to describe the feasibility of a scaffolding-based physics e-module based on the results of expert validation. The product validity test was carried out by three experts who assessed the content aspect, presentation aspect, language aspect and media aspect.

Based on the results of the validity test, it is known that the product that has been made is in the very valid category with the percentage of content validity 84.2%, presentation validity 89.3%, language validity 86.1%, and media validity 83.3%. Based on the results of the average validation of the content aspect, presentation aspect, language aspect and media aspect carried out by 2 expert judges and a practitioner, it was found that the Scaffolding-based physics e-module is oriented to critical thinking on the Static Electricity material developed in the "very good" category with an overall average percentage of 86%.

The suggestions or input from the validator are used as a reference for revising the e-module so as to produce a decent product in terms of content, presentation and language aspects. The revisions that have been made include replacing the bibliography, changing the scan view, adding the Scaffolding aspect to the practice section and reducing the file size. With an overall average percentage of Validation of 86% from a maximum score of 100%, this shows that the e-module that has been developed is in the very valid category and is suitable for use by educators and students to support learning in schools. After knowing how the feasibility of the e-module is, it can be seen the characteristics of the e-module that has been developed.

The characteristics of the Scaffolding-based physics e-module on this Static Electricity material are identified by using a characteristic identification sheet. This scaffolding-based e-module is an e-module that provides physics learning in accordance with Core Competencies and Basic competencies, presenting Contextual material equipped with sample questions and practice questions to make it easier for students to understand the material. The e-module is easy to use without having to use complicated applications, there are instructions for use to make it easier to use the e-module. E-modules provide various assistance to students to solve problems and slowly help is removed when students are considered to be able to learn independently. According to research results [17–19] the gradual assistance provided by the teacher (scaffolding) can assist students in building knowledge during the learning process. This study uses Scaffolding level 2 in making e-modules to help students build their understanding in the learning process. The forms of assistance that appear in the e-module in the form of interactions include explaining (explaining), which conveys the concepts being studied, namely Static Electricity material, Reviewing (reviewing), which is refocusing students' attention and Restructuring (rebuilding understanding), namely simplifying something abstract so that students can understand. The interactions used are relevant to the study [20].

E-module invites students to think critically by bringing up aspects of critical thinking and providing assistance (scaffolding) to help students solve problems that require students to think at a high level and which are considered difficult for students. The e-module brings up critical thinking indicators in each e-module chapter.

This is relevant to research [21] which states that the ability to think critically is not an ability that can develop by itself along with human physical development. Critical thinking skills must be trained through the provision of a stimulus that requires a person

to think critically. in the developed e-module One of the stimuli provided is in the form of scaffolding that appears in this e-module in the form of guiding questions that will help students build knowledge and finally students can answer questions that contain critical thinking indicators with scaffolding students will be able to independently answer critical thinking questions. This is relevant to research [19] which states that students with low abilities need more scaffolding so that students with low abilities can improve their critical thinking skills on each indicator.

E-modules are easy to use using uncomplicated media and are suitable for use during online and offline learning. This e-module raises critical thinking indicators such as Analysis, Evaluation, Inference and Explanation. In the e-module there are three discussion chapters that contain material presented in the form of learning videos, student worksheet, practice questions, Evaluation Questions, summaries, glossaries and bibliography that are useful for making it easier for students to learn Static Electricity material in high school.

Based on the results of the student response test conducted at three schools with a sample of 75 students, it is known that the Scaffolding-based e-module that has been made gets a very good response with a percentage on the presentation aspect of 82.1%, the material aspect 82.1% and usability aspect 82%. From these three aspects, an average value of 82.1% was obtained from the maximum value of 100%. This shows that the category of e-modules based on student responses is in the very good category.

From the category value obtained, it shows that students respond very well to the existence of this e-module. These results were obtained because students felt that they really needed a source of learning materials other than books that had been provided by the school that were in accordance with the needs of learning at school both online and face-to-face. This is relevant to research [13] which states that students are interested in using the Scaffolding-based science module because the student module was developed to make it easier for students to learn it independently.

This research is relevant to the research conducted by Suryaningsih, Medriati and Purwanto [15] entitled "Development of Scaffolding-Based Worksheets Oriented to critical thinking on Newton's Law material at Bengkulu city State High School" the validity value obtained by the study was 89%. The validity results obtained are relevant to this study which obtained 86% validity. This research is also relevant to the research results of Setyarini and Subiki [19] which states that by using scaffolding students can be helped to work on critical thinking problems. The advantages of this e-module compared to previous research are: (1) Displaying learning materials/activities that are different from Static Electricity e-modules in general, namely by using video, using technological media that allows students to read e-modules in 3D so that like reading a book in physical form. (2) Displaying varied scaffolding content in the form of animated video assistance to simplify concepts that are difficult for students to understand, assistance in problem solving, and motivation. (3) Showing aspects of critical thinking so that students are encouraged to think at higher levels, as well as. (4) Encouraging students to study independently because it contains practicum activities and practicum questions that require students to be more active in learning activities.

The weakness of the Scaffolding-based e-module research using the flip PDF Professional application is that e-modules are difficult to access via mobile phones. During

product development there are several obstacles. The obstacles faced when developing e-modules were due to the Covid-19 pandemic so that schools were carried out online, therefore development could only be carried out in 3D, namely Define, Design and Develop. So the research cannot be continued to the Disseminate stage.

4 Conclusion

The characteristics of scaffolding-based physics e-modules that have been developed are (a) e-modules that provide complete physics learning materials in accordance with core competence and basic competencies on static electricity; (b) presenting Contextual material that is equipped with sample questions, material explained using videos, student worksheet, practice questions and evaluations to make it easier for students to understand the material; (c) Displaying varied scaffolding content, namely in the form of animation assistance to simplify concepts that are difficult for students to understand, assistance in problem solving, and motivation that can make students feel not monotonous in the learning process, so that students can learn independently. (d) Showing aspects of critical thinking so that students are encouraged to think at higher levels. (e) E-modules are easy to use without having to use complicated applications, there are instructions for use to make it easier to use e-modules so that e-modules can be studied both in online and offline learning that students can use to study independently. (f) simplifying the tasks given to students and modeling the solution of the given task, focusing on providing assistance to aspects that students have not yet mastered and providing models so that students can learn with the given model. Based on the results of student responses to Scaffolding-based e-modules on Static Electricity material, they are in the very good category, it is shown by the positive response from students.

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