E-Module Based on The Android Application for Electricity and Electronics Courses

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A B S T R A K

Masih banyak kegiatan pembelajaran yang kurang berjalan dengan optimal dikarenakan kurangnya bahan ajar pendukung. Hal ini berdampak pada motivasi belajar mahasiswa yang rendah. Tujuan penelitian untuk menghasilkan E-modul berbasis aplikasi android yang valid dan praktis. Jenis penelitian ini yaitu Research and Development (R&D) dengan model pengembangan 4-D (Four D). Pada penelitian ini terdapat dua validator yaitu validator materi dan media. Metode yang digunakan untuk mengumpulkan data yaitu observasi, wawancara, dan kuesioner. Instrumen yang digunakan untuk mengumpulkan data yaitu kuesioner. Teknik yang digunakan untuk menganalisis data yaitu analisis deskriptif kualitatif, kuantitatif, dan Uji gain score. Hasil penelitian yaitu hasil analisis angket dari validator memperoleh nilai rata-rata 0,89 yang dikategorikan valid. Untuk angket praktikalitas diisi oleh dosen dan mahasiswa yang setelah dianalisis memperoleh nilai rata-rata 88% yang dikategorikan sangat praktis. Uji keefektifitasan dilakukan berdasarkan nilai KKM yang diperoleh mahasiswa, yaitu nilai di atas KKM sebesar 86% dan hasil nilai gain score adalah 0,64, sehingga E-modul yang dikembangkan dapat dikatakan efektif. Disimpulkan bahwa E-modul berbasis aplikasi android materi listrik dan elektronika layak digunakan karena dapat meningkatkan hasil belajar mahasiswa.

A B S T R A C T

Many learning activities still need to run optimally due to the need for supporting teaching materials. It has an impact on low student learning motivation. The research objective is to produce a valid and practical Android application-based E-module. This type of research is Research and Development (R&D) with a 4-D (Four D) development model. In this study, there were two validators, namely material and media validators. The methods used to collect data are observation, interviews, and questionnaires. The instrument used to collect data is a questionnaire. The techniques used to analyze the data are descriptive qualitative analysis, quantitative, and gain score test. The research results are the results of the questionnaire analysis from the validator, obtaining an average value of 0.89, categorized as valid. The practicality questionnaire was filled in by lecturers and students who, after being analyzed, obtained an average score of 88%, which was categorized as very practical. The effectiveness test was carried out based on the KKM scores obtained by students; namely, the score above the KKM was 86%, and the gain score was 0.64, so the E-module being developed can be said to be effective. It was concluded that E-modules based on android applications on electricity and electronics are appropriate to use because they can improve student learning outcomes.

1. INTRODUCTION

Students' education at school must be well-designed to optimize learning activities. Learning is an activity carried out by the teacher programmed in an instructional design that creates a process of interaction between fellow students, teachers, and students with learning resources (Akbar & Anggraeni, 2017; Nugraha et al., 2016; Suryawan et al., 2021)—learning aims to create continuous changes in the behavior and thinking of students in the learning environment (Astuti et al., 2020; Widiana et al., 2018). One sign that someone has learned something is his behavior change. Changes in behavior include changes in knowledge (cognitive) and skills (psychomotor), as well as changes in values and attitudes

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(affective) (Calafato, 2020; Daunic et al., 2021; Kim et al., 2021). Learning is related to building good interactions between the two components, namely teachers and students. Good interaction can be described as a condition where the teacher can make students learn quickly and are motivated by their desire to learn what is in the curriculum according to their needs. Learning emphasizes that students are conscious beings and can understand the importance of learning to meet their needs and adapt to the environment (Argaw et al., 2017; Hill et al., 2020; Schneider & Bodensohn, 2017). In the learning process, the figure that plays an important role is the learner. The teacher's presence is intended to encourage students to be willing and able to learn optimally (Buchanan, 2020; Goodwin et al., 2016).

However, the current problem is that many learning activities still need to run optimally. Previous research findings also show that there are still many monotonous learning activities (Cemara & Sudana, 2019; Widiartini et al., 2019). Other findings also state that the lack of use of innovative learning models causes learning activities to run less than optimally it has an impact on students' boredom when participating in learning activities (Agustiana et al., 2020; Pramilu et al., 2019; F. A. Wulandari et al., 2019). Other research findings also state that many teachers still need teaching materials (Martha & Andini, 2019; Melihayatri & Ramadan, 2019). Based on the results of interviews conducted on electricity and electronics studies in the Automotive Engineering study program, FT UNP, this has been carried out using conventional modules. This module has weaknesses in that the material presented is too concise, the formulas and examples of data processing are still lacking, the design is not attractive, and the supporting images are also lacking. In the subject of electricity and electronics in the Automotive Engineering study program, three credits are studied (2 theory and one practice). This course aims to enable students to understand basic electricity in automotive engineering applications. Students who practice electricity and electronics in the Automotive Engineering study program already use the module books provided. The module book that has been implemented as a whole shows good results. It is just that there must be improvements and additions starting from attractive designs, formulas, materials, and examples of data processing and packaged in the online form (E-module).

Based on these problems, the solutions are to use technology to develop teaching materials. Developments have influenced the field of education in information and communication technology which can be used to encourage the development of independent learning with online or distance systems (Attard & Holmes, 2020; Lukita et al., 2020). It has resulted in great demand for modern learning instruments, such as computer applications, videos, and various tools incorporating visual, audio, and text elements. An interactive learning process can be created by utilizing technological developments, one of which is creating teaching materials that are packaged attractively (Darmaji et al., 2019; Fonda & Sumargiyani, 2018; Serevina et al., 2018). Teaching materials are distinguished by their form (print, audio, and video) and use (projected and non-projected). The rapid development of the times has made teaching materials not only limited to teaching materials in the form of physical books but can be taken from a wide variety of sources, namely from the internet or other sources such as E-modules. Modules designed with special software and using a computer or electronic device as a medium for reading them are called E-modules (Seruni et al., 2020; Triwahyuningtyas et al., 2020). Electronic modules (e-modules) are the result of adaptations of printed modules or other teaching materials developed in digital (electronic) form. (Elder et al., 2019; Hamzah & Mentari, 2017). Making E-modules has the same goal as regular modules: achieving predetermined competencies.

Other research findings also state that E-module utilizes technology, which is very practical (Darmaji et al., 2019; Handayani et al., 2021). Other research findings also state that a good E-module can be applied in learning activities to facilitate students' learning (Asrial et al., 2020b; Resita & Ertikanto, 2018). This E-module is very necessary for learning activities. The advantage of using E-modules is that students with creative ideas will make them more comfortable in learning and find it easier to understand the material. The completeness of teaching materials and the teaching style of educators are also key to learning. Referring to this research, improving the electrical and electronic modules is necessary. One of the advantages of the android application is the ease of use. There needs to be a study on E-modules based on android applications for electricity and electronics courses. This study aims to develop an E-module based on an android application for electricity and electronics courses. It is hoped that the Android application-based E-module will make it easier for students to study electricity and electronics courses.

2. METHOD

The type of research used is Research and Development (R&D). The steps of all activities can be accounted for in developing existing products or creating new and different products from before, which is the meaning of Research and Development (R&D). The more systematic and precise stages used in developing this lesson are the 4-D model, namely define, design, development, and disseminate (Rewatus

et al., 2020). In the define or problem definition stage, identification of learning requirements is carried out in the material to be studied with five stages, namely front-end analysis (obtaining some of the problems experienced by students in learning), learner analysis (getting an overview of the devices to be developed for students), task analysis (obtaining the minimum competencies that students must have), concept analysis (obtaining a concept map of teaching materials), and specifying instructional objectives (obtaining learning objectives that will be used in the developed E-module).

At the design or design stage, the developed E-module is carried out by studying the competencies that must be achieved, determining the concepts of the material that will be in the E-module, and creating E-modules that make it easier for students to learn. The developed e-module is designed using a computer and software by collecting videos and images to be included in the application. Images will be edited using Photoshop, videos will be edited using a movie maker, and applications will be made using Android Studio. At the development or development stage of the E-module, expert appraisal and developmental testing are carried out through validity and practicality tests. Professional experts conduct validity testing to evaluate the developed E-module product so that weaknesses can be found and corrected. The practicalization test was carried out to see the level of practicality (ease of use, cost, and time used) of the E-module product when used through a questionnaire by research subjects (lecturers and students) with an assessment of the components of content, presentation, and benefits.

The methods used to collect data are observation, interviews, and questionnaires. The instrument used to collect data is a questionnaire. The techniques used to analyze the data are descriptive qualitative analysis, quantitative, and gain score test. Students carry out the effectiveness test of the E-module to see the effect of using the E-module, which is expected to optimize student learning outcomes. The effectiveness of the E-module is known by using learning outcomes instruments. The effectiveness test is seen from the value compared to the Minimum Passing Criteria and the gain score. Determination of Graduation Criteria Minimum graduation is determined through discussion with the course lecturer, which is 70 with B quality. The Minimum Passing Criteria value only looks at the post-test scores obtained, and the gain scores are used as pretest and post-test values. The pretest is carried out before students use the developed E-module, but students already have initial knowledge obtained in high school or vocational school. For the post-test, students are asked to use the E-module used first, then complete the post-test questions. At the stage of disseminating or disseminating E-module development, products have been tested and improved so that they are expected to be useful for the teaching and learning process.

3. RESULTS AND DISCUSSION

Results

Based on the research procedures that have been carried out, an Android application-based E-module is produced on electricity and electronics material for the FT UNP Automotive Engineering study program. The 4-D development model is used in this study with the following stages. First, define. At this stage, a needs analysis is carried out to find and determine the problems in students in electrical and electronics practicums by distributing questionnaires filled out by students. After distributing the questionnaire, it was seen that students needed a better practicum module. Students want modules that are more complete and accessible at any time. Students feel bored with the modules used because they are colorless or only photocopied, reducing motivation to learn. Students hope that there will be other teaching materials with better quality that can be used as practicum modules in electricity and electronics courses. Analysis was also carried out to determine each student's smartphone ownership. Almost all students use smartphones and enjoy learning through the material on them because they can be carried and read anytime and anywhere. Materials on smartphones are also interesting because of the varied and colorful designs. The problem is that students need help finding the smartphone module application which can be used as teaching material.

In student analysis, interviews were conducted with lecturers about representation, learning motivation, and student age. The characteristics of students in learning are that their academic ability is heterogeneous, like things with interesting pictures and designs, and an average age of 18-19 years. Task analysis includes course objectives and main competencies. This course aims to provide students with knowledge and understanding of basic electricity in automotive engineering applications, including resistors, transistors, diodes, relays, and electrical system circuits. The main competency achievement after completing this course is that students can distinguish the functions and applications of basic electrical components in automotive applications and apply them to simple electrical circuits.

Concept analysis is carried out to identify the main concepts that will be used later and to identify supporting concepts that are relevant and related to electrical and electronic materials. The main concept in electricity and electronics is that students can understand and apply the material to simple electrical

circuits. The material that students will learn in this module is electrical and electronics practical tools, resistors, resistor circuits (series and parallel), capacitors, diodes, relays, and transistors. Students must achieve main competencies, supporting competencies, and soft skills.

Second, design. At this stage, the E-module design that has been developed is produced. This e-module is designed to refer to the learning objectives to be achieved. Android application-based e-modules are made so that students have teaching materials that contain complete material and can be used as practicum modules equipped with pictures and videos. This e-module also provides practicality to students because they can study via smartphone and do not need to carry books anymore. E-module development is designed using Android Studio software and several websites with different functions. The software and website used in designing this E-module are; (1) android studio to create applications, (2) photoshop to edit photos, (3) format factory to edit videos, (4) http://waifu2x.udp.jp/ to increase image resolution, and (5) https://compresspng.com/ to reduce the image.

The developed e-module has 85 pages consisting of a title page, instructions for use, preface, table of contents, practicum objectives, introductory theory, materials and tools, work steps, data analysis, videos, pictures, and formulas. This e-module comprises eight learning materials: electrical and electronics practical tools, resistors, circuits (series and parallel), capacitors, diodes, relays, and transistors. This Android-based e-module that has been designed can be used on smartphones offline and online. This learning media consists of a start page, preface, instruction page, table of contents page, and the front page of the material contained in Figure 1. The start page, as an opener, will be displayed for a few seconds and will go straight to the preface. The Foreword will appear for a few seconds and automatically switch to the help page. On the guide page, a button will direct the user to the table of contents page, where several buttons can be selected. If one of the material buttons is clicked, it will switch to the material's front page, and students can select and click on the subchapter they want to study. On the table of contents page, besides containing material buttons, there are also buttons containing a syllabus, pictures, formulas, and videos. Third, development. The development stage was carried out to produce valid and practical Android application-based E-modules on electrical and electronic material in the Automotive Engineering study program. The development results are presented in Figure 1.

Figure 1. The Appearance of the Electrical and Electronic E-Module

Validity E-module based on an android application is a research product that has been said to be valid if it meets certain requirements. Validity can be interpreted as truth, correctness, strengths, or validity by several experienced experts to evaluate product designs and identify weaknesses and strengths. Validation in the study was carried out by several experts, who were then collected and analyzed to determine the average of each aspect with an average score of 0.667 aspects. Test the validity of the Android application-based E-module using a validation sheet by two validators. Material and media validation tests were each carried out by one expert. The validator assesses the E-module that has been developed by considering material and media validation. The results of the analysis of the material validation test assessment data for Android application-based e-modules in the electricity and electronics courses are presented in Table 1.

Table 1. Validity Test Results

Aspects that are assessed	Assessment	Category
Test the validity of the material	0.87	Valid
Media validity test	0.91	Valid
Average	**0.89**	**Valid**

Table 1 data shows the results of the material and media validation test for the development of Android application-based E-modules in the electricity and electronics courses categorized as valid with an average value of 0.89. In the material validity test, an assessment was carried out from the aspects of content, learning, and summary, with data processing results, obtained a score of 0.87 with a valid category. In terms of content, validity was obtained because the Android application-based E-module on electricity and electronics follows the achievements of basic competencies and can become teaching materials that students can use. In the media validity test, an assessment was carried out from the display, programming, and utilization aspects, with data processing results, and obtained a score of 0.91 with a valid category.

The practicality of developing E-modules can be seen from practicality tests and product usability. A practicality test was carried out to determine the level of practicality and usability of the E-module based on the android application for the electrical and electronic materials developed, seen from the results of limited trials. It is done by giving practicality test sheets to lecturers and students to obtain practicality data. One lecturer and 20 students carried out the practicality test of the Android application-based E-module. The results of the E-module practicality test are presented in Table 2.

Table 2. Practicality Test Results

Aspects that are Assessed	Assessment	Category
Lecturer practicality test	91.00%	Very practical
Student practicality test	84.00%	Very practical
Average	**88.00%**	**Very practical**

Data from table 2 shows the results of practicality tests by lecturers and students on the development of E-modules based on android applications on electricity and electronics, which have a very practical category with an average score of 88%. Practicality tests were carried out on lecturers and students. Lecturer practicality tests were carried out on learning aspects (curriculum), materials, and displays, with data processing obtaining a score of 91% in the very practical category. Student practicality tests were carried out on learning, display, and programming, with data processing obtaining a score of 84% in the very practical category. Overall, the development of E-modules based on android applications on electricity and electronics in the Automotive Engineering study program is practical, scoring 88% in the very practical category.

The effectiveness of using the developed android application-based E-module is reviewed in two ways, namely by looking at the achievement of the Minimum Mastery Criteria classically and through the gain score test. Classical completeness is seen from the percentage of students who complete (compared to the value of the specified Minimum Completeness Criteria) after using the Android application-based E-module. The basis for determining the effectiveness of the android application-based E-module is if the percentage of students' classical completeness is greater than or equal to 85%, then the Android application-based E-module is effectively used. The results of the data analysis show an analysis of the effectiveness of the Android application-based E-module. The number of students who have completed is 18 students (86%). It shows that classical mastery has been achieved, and it can be concluded that the developed Android application-based E-module is effectively used when viewed from classical mastery.

The classical completeness test functions to see the number of students who can pass the Minimum Completeness Criteria. Students who have used the Android application-based E-module are given a post-test to see the level of student understanding of electricity and electronics with the help of the developed E-module.

The gain score test is used to analyze the results of the pretest and post-test, which aims to test the effectiveness of the treatment given to a particular group. The gain score test result is 0.64. The effectiveness of the developed Android application-based E-module is in the medium category, so it is suitable for improving electricity and electronics learning outcomes in the Automotive Engineering study program. The post-test results showed that students with basic knowledge got higher scores because of the questions previously left unanswered, but after using the E-module, students found the answers. Likewise, students who previously had the basic knowledge needed higher pretest scores. However, after learning to use the E-module and understanding the material, the post-test scores were higher than the pretest.

In addition to students' initial knowledge, the gain score test is also seen from the school of origin and the difficulty level of the questions. From the data collection results of automotive engineering students, there were 11 people from SMK and ten from SMA. Students from SMA got a pretest score of ≤64, totaling eight people and six from SMK. For scores ≥ 65, two students from SMA and five from SMK. It can be concluded that the origin of the school does not significantly affect the results of the student's pretest, and it can be considered that the student's initial knowledge is the same. A test was carried out for the pretest and post-test questions to see each question's validity, reliability, and difficulty level. For the 30 pretest and post-test questions, there are five difficult questions, fifteen medium, and ten easy questions. Data analysis of gain score test results showed differences in student pretest and post-test scores after using the developed E-module in the moderate category, so it could be concluded that the developed E-module had been effectively used in learning.

Discussion

Based on the assessment results of the two tests, it can be concluded that the developed E-module is effective to be applied and used by students of the Automotive Engineering study program. The Android application-based e-module also uses videos and pictures to make it easier for students to understand this electrical and electronic material. It is also reinforced by the findings of previous studies, which state that the use of video will facilitate students' understanding of learning (Kurniawan et al., 2018; Mutia et al., 2018). Other findings also state that using images will attract students' interest in learning, increasing learning motivation (Dames et al., 2019; Halimah, 2019; Lisdayanti et al., 2014). In the learning aspect, the validity of the presentation component is obtained because the Android application-based E-module material is arranged according to the learning outcomes that students must achieve. Images and videos are added to the E-module to vary the delivery of material to increase student interest in learning. Pictures and videos are useful for helping students who are slow to accept and understand lessons (Puspita et al., 2016; Tembang & Suharjo, 2017). In the summary aspect, validity is obtained because the Android application-based E-module has three types of summaries: video summaries, formulas, and pictures making it easier for students to learn the material.

In the display aspect, validity is obtained because the Android application-based E-module is presented by considering all things from color, font size, font style, design, and arrangement of paragraphs so they can be read properly. The images and videos are of good quality, making them easier to learn (Pramana et al., 2016; Y. Wulandari, 2020; Zikky et al., 2017). In the programming aspect, validity is obtained because of the easy operation of the E-module, the precise function of the right buttons, and the interaction with the E-module is also very easy. Validity is obtained in the utilization aspect because the Android application-based E-module is displayed in an easy-to-understand language. The existence of visual appeal can increase the interest and motivation of student learning (Ario, 2019; Tegeh et al., 2019; Widiyasanti et al., 2018). Other research findings also state that the suitability of the language used in the E-module will make it easier for students to learn (Astalini et al., 2021; Solihudin JH, 2018)

In the learning aspect (curriculum), making E-modules based on android applications pays attention to the suitability of learning aspects. Learning aspects consist of learning objectives, material suitability, effectiveness, and variations in information delivery (Hamzah & Mentari, 2017; Sa'diyah, 2021). In the material aspect, the Android application-based E-module is presented with attention to actualization and actualization to the language used so that it is categorized as very practical. In terms of appearance, the Android application-based E-module has an attractive appearance. Previous research findings state that an attractive display can motivate students to learn (Asmi et al., 2018; Sofyan et al., 2019; Subarkah et al., 2021). In the learning aspect, creating an android application-based E-module is designed to make it easier for students to understand the material and provide practicality in learning so

that it is categorized as very practical. In the programming aspect, this E-module is also very easy to operate. Practicality in using E-modules will increase students' enthusiasm for learning (Asrial et al., 2020a; Pertiwi, 2019). The advantage students feel when using this Android-based E-module is that the material is complete, easy to read anywhere, and very helpful in understanding the material. This research implies that the developed E-module is suitable for use in learning so that it makes it easier for students to learn.

4. CONCLUSION

Android application-based e-modules on electrical and electronic materials get categories and are very practical. E-modules based on android applications on electricity and electronic material is suitable for learning. The results of the effectiveness test of the Android application-based E-module on electricity and electronics material have an effective category, as evidenced by the increased student learning outcomes. Android application-based e-modules can improve student learning outcomes.

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