Developing Wiper and Washer System Electronics Learning Module for Automotive Engineering Education Students

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Abstract. This research aims to develop and determine the feasibility of wiper and washer electronics learning module for Automotive Engineering Students. The development method consists of seven stages including (1) problem analysis, (2) product design, (3) product development, (4) product trials, (5) product revisions, (6) trial test, and (7) final product. The module were validated by two material experts and two media experts. Furthermore, there were 30 students participated in the trial tests. The results of this study is the electronics learning module of the wiper and washer system with a file size of 30.6MB and APK package format so that it can be operated using an android with a minimum specification of 2GB RAM. Electronics learning module contains basic theories, animations, and quizzes of the wiper and washer system. The expert validation showed that the content is very good (120) and the appearance is good (91), while the students who try to use the module rated it as very feasible (123.97). The result indicates that the electronics module of wiper and washer system are feasible to use and need to be implemented for further action research.

1. Introduction

The Automotive engineering education department has a mission to train pre-service teacher. The students are taught the knowledge, skills, and attitude related to both instructional and automotive technology. The Automotive engineering education program is implementing a competency-based curriculum based on the Indonesian National Qualifications Framework (KKNI). Graduates from this department are trained with the teacher’s competencies such as how to design, implement, evaluate, and manage classroom activities[1]. They also posses theoretical and practical competencies in automotive technology such as engine, body, power train, and electrical system. Electrical system consists of starting, charging, ignition, wipers, and accessories systems.

Additionally, there are some problems with the limited time and the amount of material that must be studied by the students in the Electical system course. This course is carried out for 150 minutes per week. It is different from learning electrical automotive in Vocational High Schools which is carried out for 360 minutes every week or 100-110 hours per semester. Limited time can affect students understanding and achievement in electrical material. Subsequently, some difficulties will occur when a student graduate from Automotive Engineering Education, Universitas Negeri Yogyakarta becomes a vocational school teacher who teach students at Vocational High School.

The Automotive electricity course especially on the wiper and washer system material is quite complicated because the material is related to a circuit and an electric current that cannot be seen directly. Therefore, students find it more difficult to visualize and understand the material because the existing flow is still abstract or invisible. There is limited modules available for facilitating the students learn about the wiper and washer courses. As a result, the students’ achievement on electric automotive course
in 2018/2019 are low. The average score was 61.5 and there were only two students who attain more than 80. The student’s attainment on this course indicate that there are some problem happens. Hence, a learning media might be promoted as a solution to solve the problem.

Learning media can be used as a tool to transmit messages and stimulate the learning process of students [2]. The selection of media in learning must also be appropriate so that it is effectively used to convey learning material. One of the learning media that is effective and easy to develop is learning module. Modules are independent learning media that are arranged systematically to facilitate the students for experiencing learning to achieve learning goals [3]. According to [4], modules are effectively used for learning because they can stimulate students to identify and solve problems with creative ideas. The effectiveness of the learning module is revealed by Patkur and Wibowo [5] study which mentioned that modules are very effective for facilitating students understanding on automotive courses.

The development of information and communication technology is crucial on the development of learning media. Learning media might be designed more effective and easy to uses using the latest information technology. Hence, an electronic module-based learning media is more effective and easier to use than print modules [6]. Electronic module-based learning media allows students to study independently outside lecture hours so that learning does not depend on the number of hours faces to face with the lecturer.

Therefore, this study purports to develop an Android-Based Learning Modules of Wiper and Washer Learning Systems in the Automotive Engineering Education Study Program, Universitas Negeri Yogyakarta. The module contains material about the wiper and washer system, animated series, and quiz. The e-learning module contains an animation of electrical circuits because abstract material can be visualized using animation assistance [7]. The use of instructional media also has a positive effect on learning outcomes and also increases student’s learning achievement [8]. It also make learning more interesting, so that student’s motivation is increasing.

2. Method

The method used in this research is the Research and Development method. This method adapted from Sugiyono [9] and consists of (1) problem analysis, (2) product design, (3) product development, (4) product trials, (5) product revisions, (6) trial test, and (7) final product.

This research was conducted in the Automotive Engineering Education Study Program, Universitas Negeri Yogyakarta. The electronic module were examined by material and media experts, and students. The instrument used in this study was a questionnaire to collect data validation from material experts, media experts, and student responses. The instrument is made based on the classification of the feasibility assessment of learning media by Surjono [10], while the material expert validation instrument includes 12 indicators, namely the suitability of the material with learning outcomes and its sequences, contextual material, containing all material, use of simple language, use of communicative language, grammar and punctuation, spelling and terms, the suitability of material with users, supporting images, supporting animation, assessment instruments, and not depending on other teaching materials. The media expert validation instrument consists of 11 indicators including layout, use of color, quality of the text, quality of supporting images, quality of supporting animation, consistency of navigation, spacing, media presentation, cognitive capacity, presentation of evaluation questions, and user ease of use. Student response instruments include 13 indicators, namely conformity with objectives, material coverage, presentation of evaluation questions, simple and communicative language, grammar and spelling, terms and punctuation, independent of other teaching materials, media design, image presentation, animation and audio presentation, navigation accuracy, ease of use, and media benefits.

In addition, a quantitative analysis is used to describe the quality of the media based on the assessment of material expert lecturers, media expert lecturers and student responses. This study uses a Likert scale in measuring the feasibility of the media. The Likert scale describes the variables to be measured into variable indicators. These indicators are used as a starting point for arranging instrument
items in the form of statements or questions [11]. The calculation of data from the results of product trials and usage trials uses an average total score.

| No. | Average score | Category      |
|-----|---------------|---------------|
| 1.  | $M_i + 1.5 \, S_{bi} < X \leq M_i + 3 \, S_{bi}$ | Very Worthy   |
| 2.  | $M_i < X \leq M_i + 1.5 \, S_{bi}$            | Worthy        |
| 3.  | $M_i - 1.5 \, S_{bi} < X \leq M_i$             | Enough        |
| 4.  | $M_i - 3 \, S_{bi} < X \leq M_i - 1.5 \, S_{bi}$ | Less Worthy   |

Source: Sudjana [12]

3. Result and Discussion
The result of this study is an android-based learning module of wiper and washer systems. The initial stage of research on the development of learning media is to extract information about the potential and problems that occur in learning Automotive electrical courses [13]. The potential solution found during the observation is that the average Automotive Engineering Education student has and uses a smartphone. Smartphones is practically used anytime and anywhere [14], and Universitas Negeri Yogyakarta is providing good internet access in the campus area.

The module contains the material, including 1) definition of the wiper and washer system; 2) the working principle of the wiper and washer system; 3) wiper and washer system components; 4) wiper and washer system electrical circuit; 5) maintenance and diagnosis of the wiper and washer system. The validation by two material experts revealed that the highest score was the material suitability and animation. While the lowest score indicator is the language, spelling, and terms. The total score of all indicators is 102 out of a maximum score of 120. Based on the feasibility table, the score of 102 is included in the “Very Worthy” category. The results of the assessment of the indicator material expert validator who got the highest score were the indicators of supporting image quality and user convenience with a score percentage of 102. The indicator with the lowest score is the indicator of the presentation of evaluation questions with a score of 58. The total score for all indicators is 91 out of a maximum score of 120. Based on the feasibility table for media experts, the score for 91 is included in the “Worthy” category. After the product is validated, an improvement was made to the e-learning modules by adding more material and improving the back sound from 27.48 dB to 22.48 dB. Improvements were also made based on indicators that received low ratings from the material and media aspects. The improvements made were completing the material, correcting words and sentences, adjusting the font size, text density, adding images, and clarifying the instructions for evaluation questions.

The next stage is the use of a trial with 30 student respondents. The total average score was 123.47 from a maximum score of 140. Based on the table, the mean score of 123.47 was included in the "Very Worthy" category. The revision stage of the product from the trial use includes improvements made concerning the writing of the material. Writing material in some parts still has typing errors, so improvements are made by checking the entire text and correcting typing errors. Finally, the electronics module of wiper and washer system are made available to all students by uploading it to Google Drive.

4. Discussion
This study produces the final product in the form of an electronic learning module of wiper and washer system. Learning media in the form of modules are suitable for learning because they can increase student’s academic achievement in learning [15]. It also facilitates students to improve their creativity and independent learning abilities[16]. A module is a learning media which helps students in the university to learn independently.
The wiper and washer system learning module has a size of 30.6 MB with an APK format, so it can be operated by android devices. The choice of android device as a medium for displaying learning media is due to the practicality of using it [17], so that it is easily accessed and used by students wherever and whenever. According to Demir and Akpinar's research [18], learning using cell phones can also improve academic achievement and increase user motivation.

The advantages possessed by the wiper and washer system learning module are the electrical circuit animation menu that can help users understand the electricity flow in the system. Users will easily understand animated visualization compared to static visualization [19]. Therefore, the animation is expected to facilitate students’ understanding of the material. There is also a quiz menu, the use of quizzes in learning can increase student motivation and involvement in the learning process [20].

5. Conclusion

Based on the results and discussion of this study, it can be concluded that the android-based learning module of wiper and washer with the APK (application package file) format, application size of 30.6 MB, and can be run on any android device with a minimum specification of 2 GB of RAM is feasible to use in the classroom activity in Automotive Engineering Education, Universitas Negeri Yogyakarta. The learning module application contains several menu options, including learning outcomes, material, animation, quiz, user manual, and developer profile. The developed media was declared very feasible (102) from the material side, feasible (91) from the media side, and feasible (123.97) from the user response. The media developed needs to be tested further in the learning process to determine its effectiveness and impact on student motivation or achievement. Also, the media being developed needs to be further developed so that it can be used on smartphones with the IOS operating system and given additional material to enrich the knowledge of students.

6. References

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