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Development of Android-Based Electronic Fuel Injection (EFI) System Learning Media

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Abstract

The aims of this research are to: (1) Develop an Android-based learning tool for Electronic Fuel Injection systems; (2) Assess the suitability of this learning material; and (3) Evaluate how well students respond to the learning material. This research uses the Borg and Gall model development method modified by Sugiyono with ten steps starting from problem identification to mass production. Data were gathered through questionnaires and analyzed using descriptive quantitative methods. The assessments by material and media experts indicated that the content, design, and appearance of the media are highly suitable, with scores of 90 and 85, respectively. Product and usage trials yielded positive feedback, with average scores of 55 and 54, respectively. The media also proved effective in enhancing student understanding, with average scores of 45 in the product trial and 43 in the usage trial.

Keywords: *Learning Media, Electronic Fuel Injection, Android.*

Abstrak

Penelitian ini bertujuan untuk: (1) Mengembangkan media pembelajaran berbasis Android untuk sistem Electronic Fuel Injection (EFI), (2) Menentukan kelayakan media pembelajaran ini, dan (3) Menilai respon siswa terhadap media pembelajaran. Penelitian ini menggunakan metode pengembangan model Borg dan Gall yang dimodifikasi oleh Sugiyono dengan sepuluh langkah mulai dari identifikasi masalah hingga produksi massal. Data dikumpulkan menggunakan kuesioner dan dianalisis dengan metode kuantitatif deskriptif. Penilaian oleh para ahli materi dan media menunjukkan bahwa konten, desain, dan tampilan media sangat sesuai, dengan skor masing-masing 90 dan 85. Uji coba produk dan penggunaan menghasilkan umpan balik positif, dengan skor rata-rata masing-masing 55 dan 54. Media juga terbukti efektif dalam meningkatkan pemahaman siswa, dengan skor rata-rata 45 dalam uji coba produk dan 43 dalam uji coba penggunaan..

Kata Kunci: *Media Pembelajaran, Electronic Fuel Injection, Android.*

1. Introduction

Education is a fundamental aspect in the development of quality and highly competitive human resources [1]. According to Law Number 20 of 2003 of the Republic of Indonesia regarding In the National Education System, the aim of national education is to develop students' potential to become individuals who are faithful, devout, of high moral character, healthy, knowledgeable, skilled, creative, and independent and who will grow into democratic and responsible citizens [2]. To achieve this goal, efforts are needed to develop an adaptive curriculum and innovative learning media that are in accordance with current technological developments.

Vocational education has experienced many obstacles, one of which is Vocational High Schools (SMK) which have to face increasingly complex challenges [3]. SMK aims to prepare graduates who are ready to work with competencies relevant to industry needs. One of the expertise programs that has great potential to be developed at vocational schools is Light Vehicle Engineering (TKR), one of which includes competencies about systems *Electronic Fuel Injection* (EFI) [4]. The EFI system is an automotive technology that is widely used in modern vehicles and plays an important role in fuel efficiency and emission reduction. So motorcycles with EFI technology require special competence to carry out repairs and maintenance [5].

However, learning about the EFI system in vocational schools often faces various obstacles [6]. Based on the results of observations at SMK N 3 Yogyakarta, it was found that many students have not reached the Minimum Completeness Criteria (KKM) on materials related to the EFI system. This is allegedly due to the lack of use of interesting and interactive learning media, as well as the dominance of conventional learning methods such as lectures. Lack of motivation to learn and limited available learning resources are also inhibiting factors in the learning process [7].

Advances in information and communication technology (ICT) today offer various opportunities to overcome challenges in the world of education [8]. One form of ICT innovation is the use of Android-based mobile devices as a learning medium. Android platform with its characteristics *user-friendly* and high accessibility, has great potential to be developed as an interactive learning medium that can be used anytime and anywhere [9]. Thus, the development of Android-based learning media for EFI system materials is expected to increase students' learning motivation and improve their learning outcomes. Based on this background, this study aims to: (1) Develop Android-based learning media that can be used to learn the EFI system, (2)

Determine the feasibility of the developed learning media, and (3) Assess students' responses to the use of these learning media. This research is expected to make a real contribution to improving the quality of learning at vocational schools, especially in the Light Vehicle Engineering expertise program.

2. Method

This study employs the Research and Development (R&D) method, utilizing the Borg and Gall model with modifications made by Sugiyono. This model was chosen because it is suitable for developing products that can be used in learning, as well as for testing the feasibility of such products. The research procedure comprises ten stages, which are: (1) identifying potential and issues, (2) gathering data, (3) creating the product design, (4) design validation, (5) modifying the design, (6) evaluating the product, (7) revising the product, (8) conducting usage tests, (9) making further product revisions, and (10) proceeding to mass production. Each stage of the research is designed to ensure that the product developed is feasible and effective as a learning medium **[10]**.

This research development model uses a modified Borg and Gall development model. This model consists of ten systematic steps as follows: 1) Potential and Problem, namely by identifying the need for Android-based learning media for the system *Electronic Fuel Injection* (EFI) at SMK N 3 Yogyakarta based on observations and interviews with teachers and students. 2) Data collection by collecting relevant data and information to support the development of learning media, including literature reviews on EFI systems and studies on Android-based applications in education **[11]**. 3) Product Design by designing *prototype* the beginning of Android-based learning media which includes EFI system materials, practice questions, and learning evaluation. 4) Design Validation by requesting the assessment of material experts and media experts to evaluate the feasibility and effectiveness of the product design that has been made. Validation is carried out using an instrument in the form of an assessment questionnaire. 5) Design Revision by revising the product based on input and suggestions from experts to improve the quality of learning media. 6) Product Trial by conducting limited trials of the product to a small group of students to test the practicality and effectiveness of the learning media developed. 7) Revise the Product by making further improvements and adjustments based on the results of product trials. 8) Trial Use by conducting a wide use trial on a number of students at SMK N 3 Yogyakarta to obtain more comprehensive data on the effectiveness of the

product. 9) Product Revision by making final revisions to the product based on the results of the use test. 10) Mass production by producing learning media products in large quantities to be widely used at SMK N 3 Yogyakarta and possibly in other schools **[10]**.

The subject of this research involves several groups, namely: 1) Material Experts, namely lecturers or teachers who have competence in the field of automotive engineering, especially in EFI system materials. 2) Media Experts, namely lecturers or professionals who have expertise in the development of technology-based learning media. 3) Students, namely grade XI students of the Light Vehicle Engineering expertise program at SMK N 3 Yogyakarta who will be the main users of the learning media developed **[10]**.

The data collection technique in this study involves several instruments as follows: 1) Questionnaire used to collect data from material experts and media experts about the feasibility of the product, as well as to measure students' responses to the developed learning media. 2) Observations made during product trials to observe students' use and interaction with Android-based learning media. 3) Interviews are conducted to get direct feedback from students and teachers regarding the learning media developed.

Data obtained from questionnaires, observations, and interviews were analyzed using descriptive quantitative methods. The steps of data analysis include: 1) Data Tabulation by collecting and compiling data obtained from expert assessment questionnaires and student responses. 2) Score and Category by calculating the average score of the assessment given by material experts, media experts, and students to determine the feasibility of the product. 3) Interpretation of Results by determining the eligibility category of learning media (very feasible, feasible, moderately feasible, or not feasible) based on the score obtained. 4) Draw conclusions by making conclusions about the feasibility and effectiveness of Android-based learning media developed **[10]**.

The success criteria of this study are measured based on 1) The learning media is declared feasible if it obtains a score of ≥ 75 from material experts and media experts. 2) Positive Response from students is declared successful if 70% or more of students give a positive response to the ease of use and benefits of learning media. 3) There is an increase in students' motivation and learning outcomes after using the developed learning media **[10]**.

3. Results and Discussion

3.1. Result

This research develops Android-based learning media for the Electronic Fuel Injection (EFI) system, following a series of development stages based on the Borg and Gall model as adapted by Sugiyono. The outcomes of this study encompass three main areas: (1) the development of the learning media product, (2) expert evaluations of the media's feasibility, and (3) student feedback on the use of this learning tool. The resulting product is an Android application designed to assist students in learning about the EFI system [6]. The app features a range of components, including instructional materials, practice questions, and quizzes. It covers topics such as the definition of the EFI system, its various types, key components, and its operation and maintenance. Visual aids and animations are provided to enhance understanding of the concepts. Android-based learning media display is presented Figure 1.

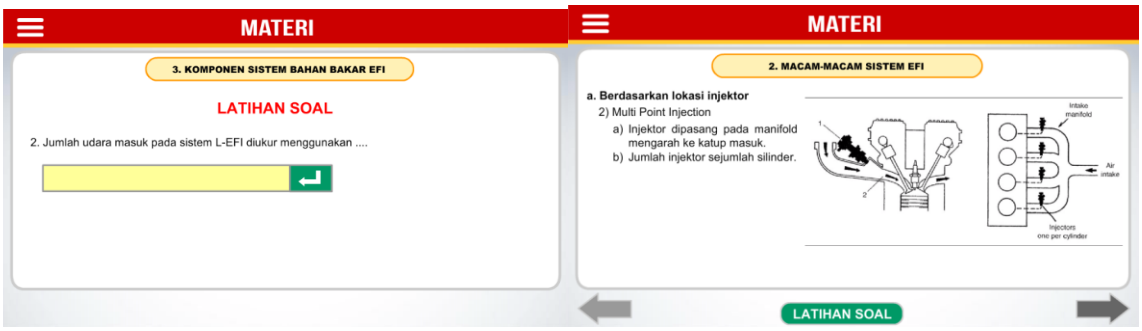

Figure 1. Android-based Learning Media Display

The app is also designed with a straightforward and user-friendly interface to ensure that it is easy for students to use. In addition, the application is equipped with an interactive practice feature that provides direct feedback to users, as well as an evaluation feature to measure students' understanding of the material they have learned [12]. The learning media developed has gone through the validation stage by material experts and media experts, There are 25 statements included in the material expert validation instrument. This validation process is carried out to evaluate the quality and feasibility of the media in terms of content, design, and technical.

Table 1. Recapitulation of the Results of the Assessment of Material Experts

No.	Alternative Answer	Shoes	Amount of Data	Total Score
1	Very Not Good	1	0	0
2	Bad	2	0	0
3	Good	3	10	30
4	Excellent	4	15	60
	Total Score			90

The material feasibility category is used to evaluate the suitability and quality of the content in the learning media. This assessment determines if the material aligns with the required standards and is appropriate for educational use. According to the results of the calculations, the material experts' feasibility categories is in **Table 2.**

Tabel 2. Media expert feasibility category

Range Score	Categories
25 - 43,75	Very Not Good
43,76 - 62,5	Bad
62,51 - 81,25	Good
81,26 - 100	Excellent

Assessment of material experts provides an assessment of the suitability of the content of the material presented in the learning media. Based on the validation results, this media received a score of 90, which is included in the category of "very decent". This assessment shows that the material presented is in accordance with the curriculum and learning needs, and is able to explain the basic concepts of the EFI system well **[7]**. The subsequent validation was conducted by media experts, utilizing an instrument comprising 24 statements. The results of the media experts' assessment are in **Table 3.**

Table 3. Recapitulation of the Results of Media Expert Assessments

No.	Alternative Answer	Shoes	Amount of Data	Total Score
1	Very Not Good	1	0	0
2	Bad	2	0	0
3	Good	3	11	33
4	Excellent	4	13	52
	Total Score			85

Based on the results of the calculation, the eligibility categories for media experts are in **Table 4.**

Tabel 4. Media Expert Feasibility Category

Range Score	Categories
24 – 42	Very Not Good
42 – 60	Bad
60 – 78	Good
78 – 96	Excellent

Media experts evaluate the design and technical quality of learning media. The results of the assessment show that this Android-based learning medium obtained a score of 85, which is also included in the category of "very feasible." This evaluation includes aspects of visual

appearance, ease of navigation, readability of text, and media effectiveness in attracting students' interest in learning [13].

This learning media has also been tested on a group of grade XI students of the Light Vehicle Engineering expertise program at SMK N 3 Yogyakarta to assess its ease of use and benefits. The trial was carried out in two stages: product trial and use trial. First, in the product trial stage, students are asked to use the learning application and provide their responses through the questionnaire provided. Recapitulation of product trial results is presented in **Table 5.**

Table 5. Recapitulation of Product Trial Results

No.	Number of Respondents	Assessment Aspects	Question Points	Total Score
1	15	Uses	15	825
2		Benefits	13	675

The results of the responses showed that the average score obtained for the ease of use aspect was 55 which was included in the category of "very easy." Meanwhile, for the usefulness aspect, this media obtained an average score of 45, which is included in the category of "very useful."

Table 6. Recapitulation of the Results of the Trial

No.	Number of Respondents	Assessment Aspects	Question Points	Total Score
1	50	Uses	15	2700
2		Benefits	13	2150

The second trial is a trial of use carried out more widely by involving more students. The results show that in terms of ease of use, this media obtained an average score of 54, which is still included in the "very easy" category. In terms of usefulness, this media obtained an average score of 43, which is still included in the category of "very useful". This shows that the Android-based learning media developed is not only easy to use by students, but also very useful for improving their understanding of EFI system materials [11].

3.2. Discussion

Based on the results of the research and development that has been carried out, several conclusions can be drawn that this study has succeeded in developing Android-based learning media designed to facilitate the learning process of students on system materials *Electronic Fuel Injection* (EFI) at SMK N 3 Yogyakarta. This learning media includes interactive features such as learning materials, practice questions, and evaluation quizzes that are presented in an attractive

and easy-to-understand manner for students [8]. The app's simple and user-friendly interface ensures that this medium can be used easily by users.

The developed learning media is regarded as highly suitable for use as an educational tool, according to the validation results from material and media experts [14]. The assessment by the material experts showed that the content presented was in accordance with the curriculum and learning needs in the vocational school, with a feasibility score of 90 (very feasible). Meanwhile, the assessment by media experts showed that the design and display of this media was in accordance with the principles of effective learning design, with a feasibility score of 85 (very feasible).

The results of product trials and use involving class XI students of the Light Vehicle Engineering expertise program at SMK N 3 Yogyakarta showed a very positive response. This learning media is considered "very easy" to use with an average score of 55 in product trials and 54 in usage trials. In addition, this media is also considered "very useful" in improving students' understanding of the material studied, with an average score of 45 in the product trial and 43 in the use trial [15]. Overall, this Android-based learning media is effective in increasing students' motivation to learn and understand EFI system materials. By obtaining high scores in terms of ease of use and benefits, this media has the potential to be widely implemented in learning at vocational schools, especially in subjects related to the EFI system [16].

4. Conclusion

Based on the results of research and development, it was concluded that the Android-based learning media developed successfully facilitated the learning process of students on the Electronic Fuel Injection (EFI) system material at SMK N 3 Yogyakarta. This media is designed with interactive features that are interesting and easy to understand, and has a user-friendly interface, making it easier for users to operate it. Validation by material experts and media experts shows that this medium is very feasible to use in learning, with a high feasibility score. The product trials and usage involving students also showed positive responses, with excellent ratings in terms of ease of use and benefits. This learning media has proven to be effective in increasing students' motivation and understanding of EFI materials, and has the potential to be widely implemented in vocational schools.

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