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Development of Android-Based Interactive Learning Media on the Application of Electronic Systems in Automotive Technology

Budhi Susilo[1]✉, Dwi Wijanarko[2], Yeri Sutopo[2]

[1]SMK Negeri 1 Warungasem, Jawa Tengah, Indonesia
[2]Pascasarjana, Universitas Negeri Semarang, Indonesia

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Abstract

Student understanding of the material is still relatively low, one of the causes being the impractical use of learning media that leverages information and communication technology. One utilization of information and communication technology is the development of Android-based interactive learning media on the application of electronic systems in automotive technology, a core subject in the automotive engineering expertise program at vocational high schools. This research aims to improve the understanding of students regarding the subject matter. The research method uses R&D (research and development) with the ADDIE model, consisting of five stages: Analysis, Design, Development, Implementation, and Evaluation. The instruments used are: (1) The product, which is an Android-based interactive learning media application called SAC, focusing on the application of electronic systems in automotive technology; (2) The product is deemed suitable based on the Content Validity Index (CVI) score from media experts, which is 0.92, and the Percentage of Agreement (PA) of 96%, while the CVI score from material experts is 0.96 and PA 98%; (3) The product trial results show a high level of effectiveness based on the Independent Sample t Test for N-gain Score with a Sig. (2-tailed) value of 0.000 < 0.05, indicating a significant difference in effectiveness between the experimental and control groups; and (4) The reproducibility coefficient (Kr) and scalability coefficient (Ks) test results are 95% and 90%, respectively, indicating that the Android-based interactive learning media on the application of electronic systems in automotive technology is very practical.

✉ Correspondence:
Keloposawit, Kalibeluk, Kec. Warungasem, Kabupaten Batang, Jawa Tengah 51252, Indonesia
E-mail: budhisusilo407@gmail.com

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INTRODUCTION

In the 21st century, it is crucial for the learning process to integrate technology to keep up with the times characterized by the millennial generation. Current students need to be accustomed to skills relevant to the demands of this era. Greenstein states that students must have deep knowledge, metacognitive skills, critical and creative thinking abilities, as well as effective communication and collaboration skills to face these changes (Manurung, 2019). Therefore, vocational education must adapt and reform its educational practices.

The basic learning process in the automotive engineering expertise program has specific characteristics focusing on developing essential competencies required by an automotive technician in a continuously evolving job market (Abugaza, 2022). This program includes fundamental knowledge and skills such as basic vehicle maintenance and repair techniques, understanding technical drawings, using tools and equipment in the workplace, automotive component maintenance, basic automotive electronics, and basic hydraulic and pneumatic systems. According to KOSP SMK N 1 Warungasem for the 2022/2023 academic year, the second element on the development of automotive technology and the job market, as well as global issues, is included in the second objective of understanding the application of electronic systems in automotive technology. This material is complex as it contains new and intricate information, requiring appropriate means and media for easier comprehension.

Students are expected to deeply understand the material. Therefore, teachers in the automotive engineering expertise program are required to develop learning methods that can accelerate student comprehension of the material, despite the time constraints set by the curriculum. As teachers, it is essential to formulate learning objectives effectively and efficiently. This aligns with Miftah's (2013) view that the achievement of learning objectives can be measured by the extent to which learning media can contribute to the classroom learning process. Consequently, teachers must select and implement appropriate learning methods, including effective learning media.

The development of information and communication technology in the form of Android has become well-known among both teachers and students. Android applications provide ease for teachers in developing creative and innovative learning media. For students, learning through Android-based media becomes more enjoyable and engaging, potentially increasing their motivation to learn. Android-based learning media are also practical and flexible, as they can be used anytime and anywhere (Nasir et al., 2022). Using Android applications, students have easy access to learning materials, interactive activities, and diverse learning resources, providing flexibility to learn according to their needs and preferences both inside and outside the school environment. In this context, Android-based learning media has become an effective means to enhance students' learning experience (Adhiono, 2021). The advantages of this media include ease of access, creativity in content development, and flexibility in learning time and place, making Android learning media a tool that can enrich the learning process and facilitate students' skill development in a continuously evolving technological era.

Based on pre-research observations conducted in the X grade of the Automotive Engineering Expertise Program at SMK N 1 Warungasem, Batang Regency, over the past two years, in line with the implementation of the Merdeka curriculum, the learning achievements in the Basic Expertise Program subject are still far below the minimum completeness criteria (SKM), with learning achievement rates only reaching 65% in the 2021/2022 academic year and 46% in the 2022/2023 academic year. The average scores for the application of electronics in the development of automotive technology are only 54.4% in the 2021/2022 academic year and 54.7% in the 2022/2023 academic year across all classes.

The low scores in the application of electronic systems in automotive technology are influenced by many factors. One aspect is the use of learning media by teachers, which is perceived as less interesting for students. The media

development used is still considered impractical and difficult to access, preventing the achievement of learning objectives. Kristanto (2016: 84) states that the concept of learning as a system includes a totality consisting of interrelated components to achieve learning goals. Several factors need to be considered in selecting media: (1) understanding the characteristics of each media; (2) aligning with the intended goals; (3) matching the learning methods used; (4) suitability with the taught material; (5) effectiveness; (6) alignment with students' conditions; (7) technical quality; (8) procurement costs; (9) availability and ease of obtaining media; (10) flexibility and convenience; (11) teachers' skills in using the media; (12) availability of time; (13) suitability with the environmental conditions. Based on these factors, Android-based interactive learning media is very suitable for use in the basic learning of the automotive engineering expertise program for the application of electronic systems in the development of automotive technology.

Several studies on the use of Android-based interactive learning media show positive impacts on student learning achievement. Research by Syahputra and Prismana (2021) concluded that the developed Android-based interactive media is suitable and feasible as a learning medium, helping the learning process to be easier, faster, and more efficient in vocational subjects at vocational high schools. The research conducted by Jaiz (2023) indicates that the SAC Android-based learning media is valid, practical, and effective in teaching. Additionally, the study by Vebrianingtias et al. (2022) concludes that the media is highly feasible, highly practical, effective, and significantly improves the basic competency in analyzing clean water pipe installation systems for vocational high school students in the Building Construction, Sanitation, and Maintenance expertise program.

The development of Android-based interactive media can serve as an alternative medium for teaching the application of electronic systems in automotive technology at vocational high schools. This media role can significantly enhance student understanding of the application of electronic systems in automotive technology.Therefore, this research aims to develop Android-based interactive learning media for teaching the application of electronic systems in automotive technology and to test its practicality.

METHODOLOGY

This research employs a Research and Development (R&D) approach using the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model is widely used in educational product and program development contexts. The quality testing of the developed product focuses on its feasibility, practicality, and effectiveness (Junaedi, 2019).

This study develops Android-based interactive learning media for the application of electronic systems in automotive technology. A qualitative approach is used to determine the level of practicality, while a quantitative approach is employed to test the effectiveness of the developed learning media.

The analysis stage involves assessing needs, facilities, infrastructure, curriculum, teachers, and students. The design process for the Android-based interactive learning media using the SAC application includes several steps: creating a flowchart, developing a storyboard, generating and collecting content, and creating the learning application using SAC.

The development stage focuses on creating the Android-based interactive learning media with the SAC application. The aim is to assess the feasibility of the designed media, validated by subject matter experts and media experts, as well as user responses from teachers and students. The results from expert judgments are analyzed using the Content Validity Ratio (CVR) and the Content Validity Index (CVI).

Table 1. CVI Ratio

Range	Category
0 – 0.33	Not Suitable
0.34 – 0.67	Suitable
0.67 – 1	Very Suitable

Source: Laowsche (1975)

The reliability of the media feasibility instruments by subject matter experts and media experts is tested using the Percentage of Agreement (PA), as shown in the table below.

Table 2. Summary of Material and Media Feasibility Tests

Type	Number of Experts	CVI Result	Agreement Result	Preparation Relevance	Description
Material Feasibility	3	0.96	0.99	99%	Very suitable and very reliable
Media Feasibility	3	0.92	0.98	98%	Very suitable and very reliable

Based on the calculations in the table, the material feasibility assessment instrument is reliable, with an agreement value of 99%, which is greater than 80%. Similarly, the media feasibility assessment instrument is reliable, with an agreement value of 98%, also exceeding 80% (Nurjanah, 2017:1170).

After validation by experts, the implementation stage is conducted with students. This stage includes an evaluation process at the end of the research. Pretests and posttests are administered to obtain initial understanding in both the experimental group using the Android-based interactive media and the control group using only textbooks or modules. Pretest results show similar initial understanding in both groups. The experimental group then receives treatment based on the Pre-test Post-test Control Group Design, followed by a posttest to evaluate learning outcomes.

The final evaluation process includes pretest and posttest data analysis to determine the effectiveness of the learning media. The pretest and posttest scores are analyzed descriptively to calculate the percentage of students achieving mastery (Lestari and Yudhanegara, 2017:235). The research subjects are grade 10th Automotive Engineering students at SMK N 1 Warungasem. Participants are divided into two groups: 10th TOT 5 as the experimental class and 10th TO 4 SMK N 1 Kandeman as the control class, each consisting of 34 students.

Data collection techniques include observation, questionnaires, and interviews. Observation assesses the feasibility of the Android-based interactive media using observation sheets. Practicality tests involve questionnaires for teachers and students. The observation and learning process assessment instruments evaluate effectiveness.

Six media and subject matter experts assess product validity and reliability using CVR and CVI to determine media and material validity, and the Percentage of Agreement to assess instrument reliability. Media practicality is determined by the reproducibility coefficient (Kr) and the scalability coefficient (Ks). Descriptive qualitative analysis is used to evaluate media practicality based on teacher and student questionnaires. The media is considered practical if the Reproducibility Coefficient (Kr) exceeds 0.90 and the Scalability Coefficient (Ks) exceeds 0.60 (Singarimbun & Efendi, 2008:118).

Effectiveness testing aims to develop the product and test its effectiveness in enhancing student understanding of the material. The Pretest-Posttest Control Group Design is used for data collection. After normality testing, homogeneity testing is conducted to assess data variance. The N-Gain score is calculated to evaluate the effectiveness of the Android-based interactive learning media. An independent T-test is then used to determine the significance of the N-Gain scores between the experimental and control groups.

Pretest and posttest data are analyzed descriptively to calculate student learning mastery percentages (Lestari and Yudhanegara, 2017:235). Students are considered to have improved understanding if their N-Gain score is ≥ 0.3. After N-Gain testing, pretest and posttest scores are analyzed using a t-test to determine significant improvement. The t-test formula (Sugiyono, 2013: 122) states that if the calculated t-score exceeds the table t-score, there is a significant difference between the data, indicating

that the Android-based interactive learning media enhances student understanding of electronic system applications in automotive technology. Conversely, if the calculated t-score is less than the table t-score, there is no significant difference between the data.

RESULTS AND DISCUSSION

The study titled "Development of Android-Based Interactive Learning Media on the Application of Electronic Systems in Automotive Technology for the Basic Expertise Program in Automotive Engineering at Vocational High Schools (SMK)" aimed to enhance student understanding and learning achievements. This research was conducted at SMK N 1 Warungasem during the even semester of the 2023/2024 academic year. The developed Android-based interactive media includes the following components:

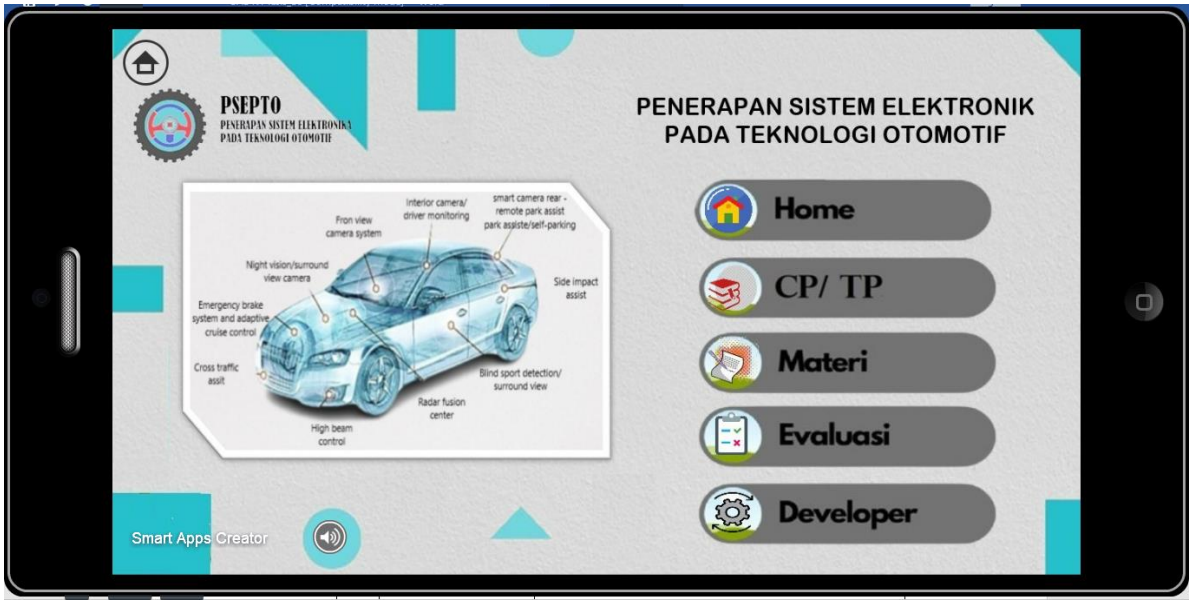

Figure 1. Main Menu of Media Development

The learning media consists of Android-based interactive learning content on the application of electronic systems in automotive technology, aligned with the learning outcomes or objectives stipulated by the current curriculum. The media developed is an application created using Smart Apps Creator (SAC) with file extensions such as APK, HTML, or EXE. The application includes an opening page or splash screen, title menu, home menu, CP/TP menu, material menu, evaluation menu, and developer menu. The resolution used is at least 1820 x 720 pixels, consistent with typical Android applications. The application file size is between 97 and 100 MB and can be used on Android smartphones and computers.

After the implementation phase, the evaluation phase was conducted to gather data on the learning process outcomes for students using the Android-based learning media in the experimental class at SMK N 1 Warungasem. The evaluation results indicated an average student learning score of 85.76, with a 100% pass rate, surpassing the Minimum Mastery Criteria (SKM).

The feasibility of the Android-based interactive learning media on the application of electronic systems in automotive technology was validated by media and material experts. This validation involved three media experts and three material experts. Based on the validation results, the media feasibility instrument was deemed "feasible" after analysis using the Content Validity Ratio (CVR), Content Validity Index (CVI), and Percentage of Agreement.

The CVR results indicated that all assessed aspects (indicators) had a CVR value ranging from 0.33 to 1. For the overall test results, the CVI

value was 0.96. To determine if the valid CVR and CVI values were consistent with expert agreement, the Percentage of Agreement was used. The Percentage of Agreement was 98%, exceeding the 80% threshold. Consequently, media experts concluded that all aspects (indicators) of the feasibility instrument for the Android-based interactive learning media were valid and reliable.

Similarly, the media experts CVR, CVI, and Percentage of Agreement results yielded a CVR range of 0.33 to 1, a CVI of 0.92, and a Percentage of Agreement of 96%, which is higher than the 80% agreement threshold. Thus, media experts agreed that the instrument for media experts was valid and reliable. The feasibility analysis using CVR and CVI indicates that the developed Android-based interactive learning media is suitable for limited implementation trials.

The feasibility of the media, based on expert assessments of various aspects consisting of 13 indicators, was validated. These indicators generally evaluate software, visual communication, content quality, and presentation of the developed Android-based interactive learning media. Key assessment focuses include the quality of display, software engineering, implementation, interface, and compatibility, as stated by Annisa et al. (2020:78), highlighting the importance of accessible and operable media components such as images, text, audio, and video.

Choosing these indicators is crucial in creating an Android-based interactive learning media for students. Faqih (2021) states that Android-based interactive learning media should incorporate animations, images, videos, music, and various menus. Wina Sanjaya in Purwono et al. (2014:130) similarly describes interactive learning media as containing visual and auditory elements, such as video recordings and slides. Anderson in Nuraeni (2018:133) defines Android-based interactivity as a series of electronic video images accompanied by audio elements.

The feasibility assessment by expert judgment focuses on display quality, software engineering, implementation, interface, and compatibility. Sambodo in Jaiz (2023:63-64) states that effective educational images should be authentic, simple, appropriately sized, and aesthetically pleasing. Arsyad in Hartono (2016:256) suggests that interactive content tailored to students' needs, including favorite colors, images, music tempo, and animation support, enhances the learning experience. Satria et al. (2023) found that developing Android-based Adobe Flash media improves student outcomes in ABS materials at SMK N 1 Singgahan. Similarly, Mutia et al. (2022:118) concluded that Android-based interactive learning media aids students in comprehending concepts optimally as a teaching tool.

A limited trial represents the implementation stage following the validation of the media by media and material experts. In this stage, the Android-based interactive learning media on electronic systems in automotive technology was tested with 34 students in grade 10th TOT 5 (experimental class). The control class, grade 10th TOT 4, consisting of 34 students, used module media. Post-treatment, both classes underwent performance tests as a form of posttest. Posttest results were analyzed for normality and homogeneity. At the end of the research process, the experimental class was given a practicality questionnaire for students and teachers.

The Android-based interactive learning media was deemed effective if there was a significant improvement in student learning outcomes. The effectiveness was analyzed using an Independent Sample t-Test on posttest results. Before this, posttest data underwent normality and homogeneity tests.

Table 3. Posttest Normality Test Results

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Class group	Statistic	df	Sig.	Statistic	df	Sig.
Post-Test Learning outcomes	Experimental	.130	34	.154	.938	34	.053
	Control	.147	34	.062	.939	34	.057
a. Lilliefors Significance Correction							

The Kolmogorov-Smirnov normality test indicated that the experimental class had a Sig. value of 0.154 > 0.05, and the control class had a Sig. value of 0.062 > 0.05, confirming normal distribution of learning outcome data. The homogeneity test using Levene's Statistic resulted in a Sig. value of 0.988 > 0.05, indicating homogenous variance of learning outcomes. Following normality and homogeneity tests, a t-test was conducted to determine the difference in learning outcomes between the experimental and control classes.

Table 4. Posttest Homogeneity Test Results

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
Post-Test Learning outcomes	Based on Mean	.000	1	66	.988
	Based on Median	.000	1	66	1.000
	Based on Median and with adjusted df	.000	1	65.570	1.000
	Based on trimmed mean	.000	1	66	.989

The effectiveness of the Android-based interactive learning media was tested using the independent sample t-test. The students' learning outcomes were analyzed with the Independent Sample t-test, yielding a t-value of 9.801 and a Sig. (2-tailed) value of 0.000, which is less than 0.05. Since the t-value of 9.801 is greater than the critical t-value of 1.670, it can be concluded that there is a significant difference in the effectiveness between the average learning outcomes of the experimental class compared to the control class. This result indicates that the formulated hypothesis is accepted (Ha accepted, while Ho rejected). Therefore, it can be concluded that the use of Android-based interactive learning media significantly improves students' learning outcomes. The N-Gain score of 0.70 indicates a high category improvement in learning outcomes for the use of Android-based interactive learning media in the experimental class compared to the control class, which used books/modules. The N-Gain value was then compared to the N-Gain Score (g) category, where a value of g > 0.7 indicates a high category improvement.

Table 5. Summary of N-Gain Score Calculation Results

Number of Respondents	Average Score of Experimental Class			Average Score of Control Class		
	Pretest	Posttest	N-Gain	Pretest	Posttest	N-Gain
34	53.53	85.76	0.70	56.00	69.53	0.30

This aligns with the views of Alpiani et al. (2022), who stated that the E-Module learning media, supported by Smart Apps Creator in Vocational High Schools, brings diverse content that engages multiple senses. Similarly, Syahputra and Prismana (2021) argued that Android-based interactive learning media, incorporating text, audio, and video, positively influence the productive learning process in Vocational High Schools. Arnandi et al. (2022) also asserted that Android-based learning media using Smart Apps Creator is highly effective and

efficient for achieving learning objectives. Gusaasi (2022) observed that student learning outcomes improve positively when teachers use Android-based interactive learning media, indicating a significant impact on students' character and learning outcomes when using Smart Apps Creator. This is consistent with the findings of Mutiasa et al. (2020), who reported that Android-based interactive learning media resulted in different learning outcomes for mathematics subjects in grade 10th at Vocational High Schools. Khaharsyah (2019) also concluded that learning through Android-based interactive learning media is both feasible and effective for use in Vocational High School programs in Light Vehicle Engineering, as it enhances cognitive understanding during lessons.

Table 6. Summary of Media Practicality Testing Data by Users

Users	Number of Respondents	Kr Value (reproducibility coefficient)	Ks Value (scalability coefficient)	Remarks
Students	34	0.94	0.87	Meets the criteria
Teachers	4	0.96	0.93	Meets the criteria

The developed Android-based interactive learning media was categorized as practical after analysis using reproducibility and scalability coefficients. The scores obtained were Kr = 0.94 for students, Kr = 0.96 for teachers, Ks = 0.87 for students, and Ks = 0.93 for teachers, indicating practicality based on criteria established by Singarimbun & Efendi (2008:118), which are Kr > 0.90 and Ks > 0.6. These results support Alpiani et al. (2022), who concluded that Android-based interactive learning media on sequences and series in Vocational High Schools met practical criteria, with an average observation score of 77.4, categorized as good. Similarly, Andrizal and Arif (2017:7) found that the practicality of Android-based interactive learning media for e-learning courses in Automotive Electricity and Electronics was very high. The media received high ratings from users, with 88.64% for material relevance, 88.86% for technical aspects, 87.75% for learning outcomes, and 87.75% for evaluation aspects. The average practicality level was 88.57%, categorized as very practical (81-100%). Thus, the media can be considered highly suitable for use as a learning tool.

CONCLUSION

The conclusions of this study, titled "Development of Android-Based Interactive Learning Media on the Application of Electronic Systems in Automotive Technology," demonstrate that the developed media is highly suitable for educational use. The expert evaluations provided high agreement ratings, indicating that the media is very appropriate as a learning tool. Furthermore, the study found that the media is effective in enhancing student learning outcomes. This conclusion is supported by the significant difference in the average post-test scores between the experimental and control classes, showing a marked improvement in the experimental group that used the Android-based interactive media. Additionally, the practicality of the developed media is affirmed by the positive feedback from users, which included students and teachers of Automotive Engineering at SMK N 1 Warungasem. They rated the media as very practical, highlighting its ease of use and relevance in the educational context. This comprehensive assessment confirms that the Android-based interactive learning media for the application of electronic systems in automotive technology is a valuable and effective tool for improving learning experiences in this field.

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