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Development of Application-Based Interactive Learning Media in Automotive Engineering

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Abstract

Learning media significantly impacts the effectiveness of the learning process. The automotive industry is experiencing rapid development, resulting in a high demand for technicians with expertise in the automotive field. The purpose of this study was to test the development of Smart Apps Creator (SAC) to create interactive learning resources for Engine Management Systems (EMS). This research and development (R&D) project used the ADDIE development approach. Five subject matter experts and five media specialists comprised an expert assessment group that validated and evaluated the media to ensure its feasibility. In addition, 62 students reviewed the learning materials as users of the application. The media specialists' evaluation of the feasibility of the learning media construction resulted in a score of 4.02, which is considered practical. The subject matter experts' evaluation of the feasibility of the learning media material resulted in a score of 4.15, which is considered practical. The students' evaluation of the acceptance of the learning media as users resulted in a score of 4.07, which is classified as practical. Meanwhile, the application implementation in the learning process proved to increase learning success among students who used the program development. All things considered, the findings of this study can be used as evidence that application-based learning materials are worthy of widespread use, which will further improve teaching standards. Furthermore, vocational teachers must innovate in developing learning media by utilizing and integrating technology into the process. The creation of such media is necessary in the 21st century to provide easily accessible and understandable learning materials so that students can effectively absorb the information.

Keywords: *Vocational Education, Interactive Learning, Learning Media, Media Evaluation, Smart Apps Creator.*

1. Introduction

Technological advancements in the fourth industrial revolution have influenced all industries, including education [1]–[3].A This digital transition necessitates a change in the presentation of information, particularly in the context of learning and knowledge sharing. Increased productivity and efficiency at work, simpler communication, and quicker access to the most recent information are some advantages of technology [4]–[6]. The rise of several digital apps that may be used as more interactive, adaptable, and adjustable learning materials or information distribution systems is one benefit of this technological advancement. With application-based media, users may access online resources, make use of interactive elements, and have a more engaging and customized educational experience [7][8]. Application-based media has benefits over traditional media in terms of effectiveness, scalability, and the capacity to provide contextual, user-centered learning.

Due to the growing sales of four-wheeled vehicles in Indonesia and technology breakthroughs, automotive engineering vocational education must modify and adapt the technical abilities required to handle the issues brought on by these changes. Such an effort necessitates the production of human resources prepared to handle obstacles in the automobile industry via vocational education [9][10]. The automotive industry's vocational high schools require suitable strategy to produce skilled workers [10][11]. Therefore, the creation of technology-based learning is one potential innovation [12]–[14]. Nowadays, most people have access to technology. However, its usage still requires additional consideration. Technology misuse may have detrimental effects on both the individual and other people [15][16]. The Electronic Fuel Injection (EFI) system is one of the most popular vehicle technological advancements. EFI technology relies on electronics in its power supply mechanism [17]. Vehicle functioning becomes more effective and efficient as a consequence. The Engine Management System (EMS) is one of the EFI's systems. It costs a lot of money in vocational education to teach pupils this technique until they grasp it. According to [17], [18], the issue in the area is that not all automotive engineering educational institutions have enough equipment and resources to educate students on how to practice EMS content.

Students are becoming more at ease studying using digital media than through books, according to recent trends [19]–[21]. It is essential that learning materials transition from traditional to digital formats [22]–[24]. Furthermore, due to the high cost of the necessary tools and materials, some institutions do not currently have all the necessary equipment to thoroughly study technology for engine management systems. However, due to field circumstances, educators have not created learning materials to the best of their abilities, which has an impact on the learning results of students. To have a major influence on learning outcomes, learning must be conducted using a combination of acceptable approaches [25]–[28]. Students' comprehension of the material given and their ability to perform satisfactorily both individually and in groups are signs of effective learning. Additionally, whether evaluated individually or in groups, student conduct that aligns with certain teaching or instructional goals is well-established.

Research into the development of learning applications is necessary to address gaps in the field. However, the creation of successful application-based media necessitates a thorough understanding of user traits, educational requirements, and relevant technological advancements. This study's main goal is to create application-based learning resources for the automobile industry's Engine Management System course. The created learning materials include the application idea, content presentation, and continuous learning assessments. To evaluate the efficiency of the built application, this study also incorporates it into the learning process. The goal of this project is to provide application-based learning materials that are simple to use and comprehend, which will improve student accomplishment and facilitate effective and efficient learning. Additionally, educational institutions may use the study results as a guide to produce learning material in a more inventive and creative manner.

2. Method

The ADDIE (Analysis, Design, Development and Production, Implementation, and Evaluation) development model, which was derived from [29], is used in this study's Research and Development (R&D) methodology, with the scheme shown in Figure 1. The final result is a learning tool that simulates content pertaining to automotive engineering's Engine Management System. The learning media development application makes use of Smart Apps Creator (SAC). Five media specialists and five material experts evaluated the viability of learning media. To ascertain the degree of user acceptability of the learning media application created in accordance with their requirements and characteristics, 62 students then took part. Additionally, two classes the Experimental Class (EC), which had 29 students, and the Control Class (CC), which had 27 students were utilized to examine how well the program worked for learning.

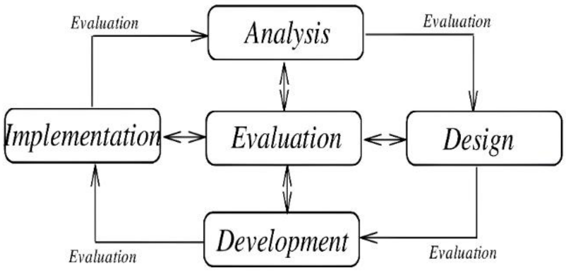

Fig 1. Research Flow

Field observation, interviews, and questionnaires were the methods used to gather data for this research. The requirements in the field were reviewed via observations. Data on the requirement for Engine Management System (EMS) learning materials in the Light Vehicle Engine Maintenance (PMKR) course was gathered via the interview procedure. To ascertain the viability of the produced Engine Management System learning materials, questionnaires were used to gather answers from students, media specialists, and material experts. The creation of this medium employed the ADDIE paradigm, which includes five steps that must be followed in a procedural manner. The first step is analysis, which comprises instructional, content, and general analysis. The second step is the design stage, which entails creating the material structure, figuring out the systematics, organizing assessment instruments, and deciding which elements, such as images, animations, and situations, may be included in the media. The third step is development and manufacturing, which involves turning the design's blueprint into a working prototype. The fourth step, known as implementation, involves testing the developed learning materials through small-scale trials. Last but not least is the evaluation stage, which entails assessing whether the learning media being created is successful and meets initial expectations, enhancing expert input regarding the viability of the learning media, and putting the application into use to observe how well it facilitates learning.

3. Results and Discussion

3.1. Stage of Analysis

Interviews with vocational instructors teaching Light Vehicle Engine Maintenance were used for general analysis. According to informant interviews, the ability of students to use and maintain an Engine Management System (EMS) is the desired competence criterion. One significant drawback of the educational resources that educators employ, including job sheets, modules, and textbooks, is that users are only able to apply the theory. Additionally, the required actions are difficult to understand, and the pictures lack sufficient detail. As a result, creating EMS learning materials that enhance student learning is essential. The qualities of the material and how to organize it to satisfy the competence standard maintaining an EMS and its core competency implementing and maintaining an EMS were ascertained via content analysis. To make user interaction easier, content is displayed page by page using "next" and "previous" navigation. The digital equivalent of turning pages in a book is this navigation. Examples of digital content pages include the homepage, menu, developer profile, instruction, required competence, material, video, jobsheet, inquiry, and reference pages. The conversion of standard competencies and basic competencies into learning indicators is known as instructional analysis. Basic skills are broken down into learning accomplishment indicators in order to do instructional analysis in learning. Mastery of the fuel supply system, electronic ignition system, electronic control system, and air induction system are the four key indications in the EMS material. The application's material section may contain these four systems.

3.2. Phase of Design

The EMS content used as learning media is included in a document that serves as the presentation design for the instructional materials. Relevant sources were utilized to create the storyboard's material narrative, animations, visualizations, and graphics. Several screens, one after the other, comprise this page. Table 1 and Figure 2 illustrate the flowchart that outlines the created educational materials. The analysis and requirements in the sector served as the basis for the creation of the flowchart.

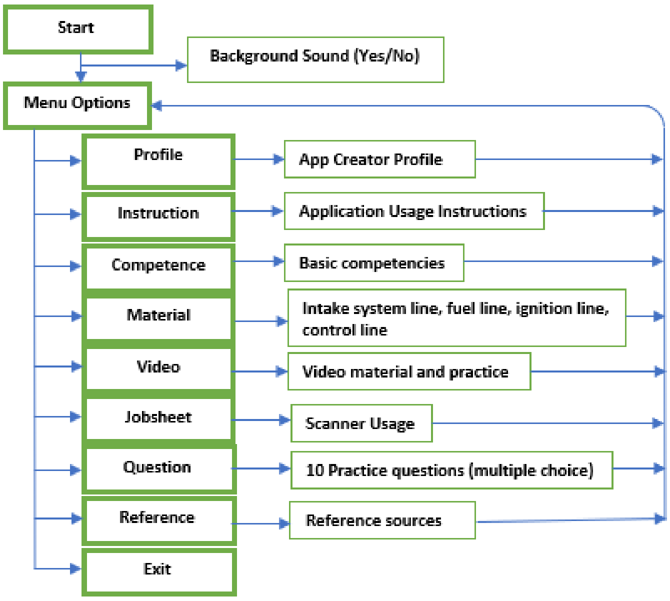

Fig 2. Flowchart of the learning media application

Table 1. Description of the application's presentation

No.	Application Page	Information
1.	Home page and menu options	When the user launches the program, there is a 5-second loading period with captivating animations before they reach the main site. The main page then displays the program title, developer name, logo, and start button. Click the start button on this page to navigate to the program menu page. During the development stage, this website will also include instrumental music to encourage students to utilize the program.
2.	Developer Profile Page	It has a "back menu" button and the biodata of the program creator. You can access the application menu page by clicking the "back menu" button.
3.	Instructions for Use Page	It has a "back menu" button and instructions on how to use the program. Users can access the application menu page by clicking the "back menu" button.
4.	Competency Page	It has a "back menu" button and the competencies that have been developed in the program. Users can access the application menu page by clicking the "back menu" button.
5.	Material Page	The following buttons are located on this page, which contains EMS material created in the application:Intake line system (which includes information about the EMS intake line system); fuel line system (which includes information about the EMS fuel line system); ignition line system (which includes information about the EMS ignition line system); and control line system (which includes information about the EMS control line system).
6.	Video Page	This page has a "back menu" button with instructional movies and animations on EMS content. A quick overview of the EMS system, an animated film that explains its parts and functions, and a movie about using a scanner to assess system damage are among the instructional films that are offered.
7.	Jobsheet Page	This site has a "back menu" button and a task sheet or practical work procedures that use a scan tool to detect damage to the EMS specified in the program. Users can access the application menu page by clicking the "back menu" button.
8.	Practice Questions Page	This page has a "back menu" option and the 25 multiple-choice questions from the application. Press the "back menu" button to access the application's menu page. Each time a user answers a question on the practice questions page, the system updates their score and displays a summary of it at the end of the page. It is recommended that users practice using a range of queries. It is envisaged that users would improve their comprehension of the provided subject via repeated practice.
9.	Application Reference Page	The application's references are given on this page, along with a "back menu" option. Users can access the application menu page by clicking the "back menu" button.

Together with the flowchart, a storyboard dissection of the material script was also made and shown on paper in layers, frame by frame. The home site, menu page, developer profile page, instructions page, competence accomplishment page, material page, video page, jobsheet page, question page, and reference page will all be necessary displays, depending on the outcomes of the analysis stage. The design of the interface will make it easier to create interfaces for the educational program. The home page has multiple navigation options: start to navigate to the main menu page; developer profile to navigate to the developer biodata page; usage instructions to navigate to the application usage instructions page; competency to navigate to the learning competency page to be achieved; material to navigate to the EMS material page; video to navigate to the learning video page; jobsheet to navigate to the practice guide page; question to navigate to the practice question page; reference to navigate to the learning reference; and exit to end the media.

3.3. Stage of Development and Production

The outcomes of the analysis and preliminary design phases serve as the basis for this step. The developer profile page, the instructions page, the competence page to be attained, the materials page, the video page, the jobsheet page, the questions page, the references page, and the start menu are the first choices on the application's home page. We created the pages of this application using Smart Apps Creator (SAC), a simulation technology. The materials page in the application contains navigation for the material list, back and next navigation, and multimedia space for the EMS material in the form of simulations. A screenshot of the learning media application's development stage may be seen below.

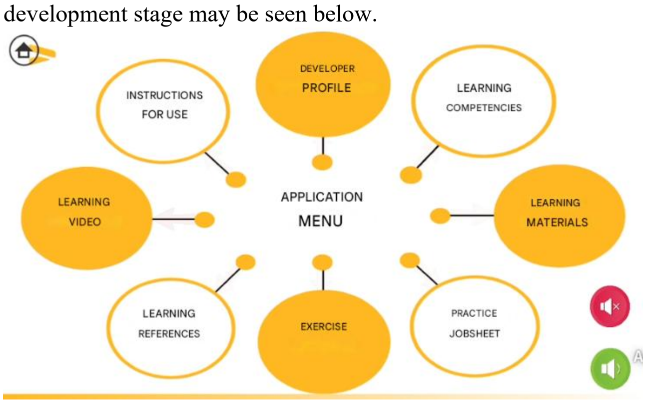

Fig 3. Application menu display

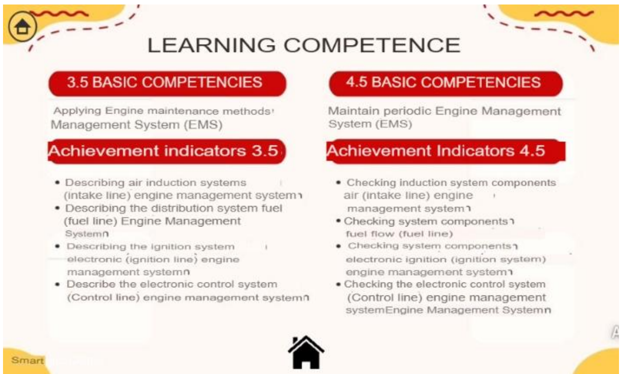

Fig 4. Display of learning competencies

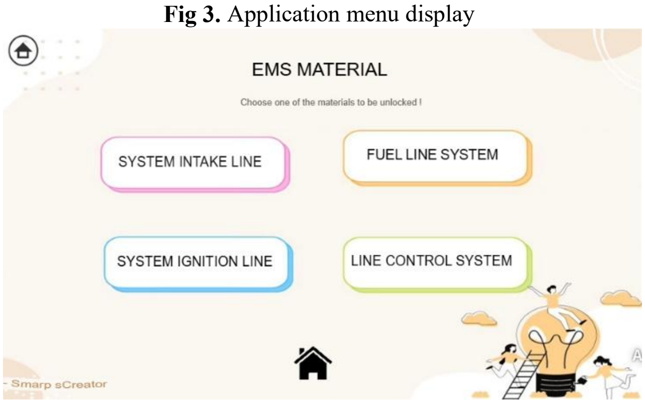

Fig 5. Display of the material options users want to open

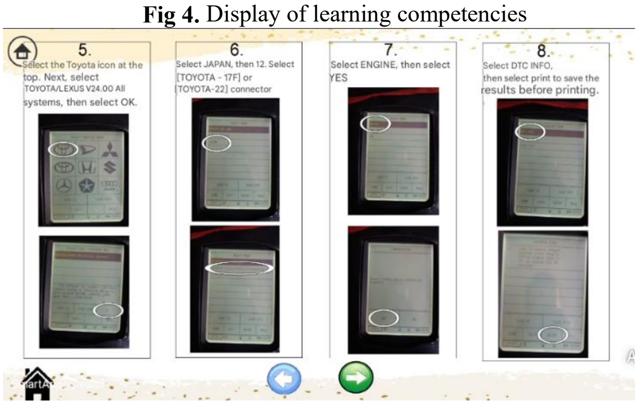

Fig 6. Jobsheet for diagnosing damage to the EMS

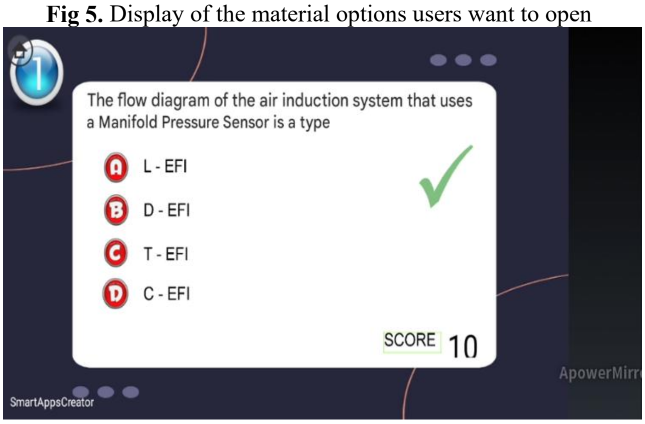

Fig 7. Display of the question if the answer is correct

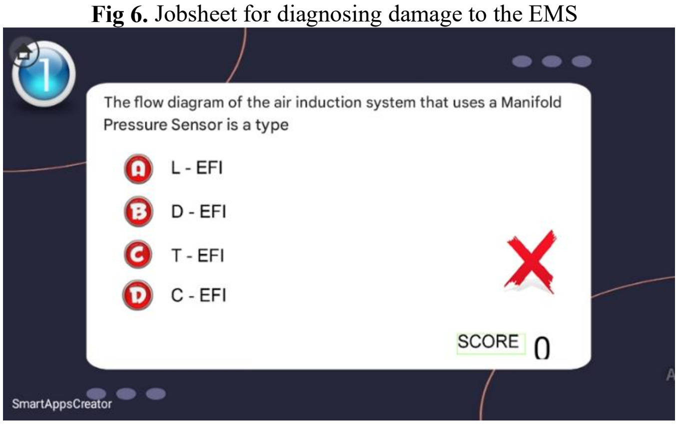

Fig 8. Question display if the answer is wrong

Upon completion of development, the interactive learning media application undergoes evaluation and verification by users, media experts, and material experts. To prepare the learning media application for general usage, this stage is taken to gather feedback for any enhancements.

3.4. Stage of Implementation

In order to ensure the suitability of the learning media, a panel of judgment experts five subject matter experts and five media experts validated and evaluated the media's viability. The application was improved after evaluations and recommendations from subject matter experts and the media. It was then put into practice with users in the field. In this case, 62 pupils used the program throughout a trial. Only the Automotive Light Vehicle Engineering program utilized the EMS learning materials. The implementation's goal was to assess the learning materials' viability from the user's perspective. The trial's student comments were then taken into account while making changes. Two sessions over the course of a week were held to apply the learning in accordance with the school calendar.

3.5. Stage of Evaluation

Media specialists', content experts', and consumers' judgments are calculated and taken into consideration throughout the evaluation step. Multimedia Acceptance measures the degree of user acceptance of the generated multimedia based on their demands and characteristics, whereas Multimedia Material Assessment and Multimedia Construction Assessment measure the degree of multimedia feasibility. Descriptive statistics are used to evaluate the viability of multimedia learning. An average score is determined by tabulating scores ranging from 1 to 5. The ideal mean (2.50) serves as the feasibility barrier, and the feasibility level is separated into four categories. The mean score in the "feasible" category is thus classified into three levels: "less feasible," "feasible," and "very feasible," A mean score below the ideal mean is understood as "not feasible." The application evaluation factors in the questionnaire are interpreted in Table 2 below.

Table 2. Interpretation of the Feasibility of EMS learning media

No.	Mean Score Interval	Interpretation
1	1.00 – 2.49	Not feasible
2	2.50 – 3.32	Less feasible
3	3.33 – 4.16	Feasible
4	4.17 – 5.00	Very feasible

3.5.1. Feasibility of Learning Media Construction

Media experts (MD) evaluated the EMS learning materials developed on Smart Apps Creator (SAC). After the evaluation, the media specialists identified the necessary changes. Five learning media experts responded to a non-test questionnaire with 38 valid score questions to assess the viability of the SAC-based EMS learning materials as judged by the media experts. Tables 3 and 4 display the evaluation findings conducted by the learning media specialists.

Table 3. Feasibility of Learning Media as reviewed by individual MD

Aspect	MD1		MD2		MD3		MD4		MD5	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Guide and information	4.00	1.00	4.67	0.58	4.33	0.58	4.67	0.58	4.33	0.58
Program performance	4.00	0.67	4.20	0.79	3.70	0.67	3.90	0.32	4.30	0.48
Systematics	3.67	0.58	4.33	1.15	4.33	0.58	4.33	0.58	3.67	0.58
Aesthetics	3.50	0.58	4.00	0.82	3.50	0.58	3.75	0.50	4.25	0.50
Narration and audio quality	4.00	0.58	3.71	0.49	3.86	0.90	4.29	0.49	4.00	0.58
Video and or animation quality	4.25	0.96	3.75	0.96	4.00	0.82	4.25	0.50	4.25	0.50
Principles of multimedia design	4.00	0.82	3.71	0.49	3.57	0.53	3.86	0.69	3.86	0.38
Average	3.92	0.74	4.10	0.75	3.90	0.67	4.15	0.52	4.09	0.51
Decision	Feasible		Feasible		Feasible		Feasible		Feasible	

Table 4. Feasibility of Learning Media in terms of all Media Experts (AM)

Aspect	Total		Decision
	Mean	SD	
Guide and information	4.40	0.28	Very Feasible
Program performance	4.02	0.24	Feasible
Systematics	4.07	0.37	Feasible
Aesthetics	3.80	0.33	Feasible
Narration and audio quality	3.97	0.21	Feasible
Video and or animation quality	4.10	0.22	Feasible
Principles of multimedia design	3.80	0.16	Feasible
Average	4.02	0.26	Feasible

Five media specialists completed the evaluation, and the average result was 4.02. Media experts evaluated the learning media's viability category and determined that this SAC-based EMS learning medium falls within that category. With an average score of 4.40, the guidance and information component received the highest score and was classified as very feasible. In addition, the following other factors were given a feasibility category: video quality (average score of 4.10), systematics (average score of 4.07), program performance (average score of 4.02), narrative and audio quality (average score of 3.97), aesthetics (average score of 3.80), and multimedia design principles (average score of 3.80). Media specialists' evaluation of the media's viability showed that the educational materials were structurally prepared for field usage.

3.5.2. The Viability of Education Media Resources

Material specialists evaluated the learning media's materials. They determined what needed to be revised after completing the exam. A non-test questionnaire with 24 questions and 5–6 material expert responses was used to assess the viability of the SAC-based EMS learning materials among material experts. The outcomes of the learning media's viability evaluation by Material Experts (ME) are shown in table 5 and 6 below.

Table 5. Feasibility of Learning Media reviewed from the perspective of individual Material Experts (AM)

Aspect	ME1		ME2		ME3		ME4		ME5	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Guide and information	4.00	0.82	4.00	0.82	4.75	0.50	3.75	0.96	4.50	0.58
Multimedia materials	4.25	0.62	4.25	0.62	4.25	0.62	4.08	0.67	4.08	0.79
Evaluation	4.00	0.76	4.13	0.64	4.25	0.46	4.13	0.64	3.88	0.64
Average	4.08	0.73	4.13	0.69	4.42	0.53	3.99	0.76	4.15	0.67
Decision	Feasible		Feasible		Very Feasible		Feasible		Feasible	

Table 6. Feasibility of Learning Media reviewed from the perspective of all Material Experts (AM)

Aspect	Total		Decision
	Mean	SD	
Guide and information	4.20	0.41	Very Feasible
Multimedia materials	4.18	0.09	Very Feasible
Evaluation	4.08	0.14	Feasible
Average	4.15	0.21	Feasible

An average of 4.15 was the total score of the respondents based on the evaluation findings that were assessed from the material by five specialists. All things considered, these findings fall into the practicable category when seen through the lens of media feasibility. The very feasible category includes information on the elements that scored the highest, namely the content or multimedia material (average score of 4.18) and the guiding and information aspect (average score of 4.20). Furthermore, with an average score of 4.08, the evaluation component was the one that was assigned to the feasible category. These findings indicate that the medium is suitable for use in the educational process since it satisfies the requirements for application content.

3.5.3. Acceptance of Learning Media

User students provided evaluations on the educational materials. Following their evaluations, the users determined necessary changes to make the material suitable for general usage. A 37-item non-test questionnaire was used to gauge how users felt about the SAC-based EMS learning materials, and 62 students answered. Student opinions on the suitability of the learning materials are shown in Table 7.

Table 7. Feasibility of learning acceptance as reviewed by users

Aspect	Total		Decision
	Mean	SD	
Guide and information	4.18	0.35	Very Feasible
Multimedia materials	4.14	0.25	Feasible
Evaluation	3.96	0.41	Feasible
Media design and facilities	3.97	0.22	Feasible
Pedagogical Effects	4.08	0.34	Feasible
Average	4.07	0.31	Feasible

With an average score of 4.07, the entire evaluation is classified as "feasible" based on the replies from students acting as consumers across a number of evaluated elements. With an average score of 4.18, the advice and information component was classified as "very feasible." Other elements were classified as "feasible," such as educational effect (average score of 4.08), media design and facilities (average score of 3.97), evaluation (average score of 3.96), and multimedia materials (average score of 4.14). The SAC-based EMS learning medium is appropriate for deployment and usage as a learning aid, according to the feasibility category findings. The bar chart in Figure 10 provides a more lucid representation of the findings of the feasibility evaluation conducted by media experts, material experts, and respondent acceptance.

3.5.4. Use of The Application on Student Performance

Two classes were used to examine the efficacy of application usage in learning: the Experimental Class (EC), which had 29 students, and the Control Class (CC), which had 27 students. A pretest was given before the treatment, with the experimental class receiving application-based learning and the control class receiving manual-based learning. A posttest was given after the administration of the learning. The acquired data was subjected to normality and homogeneity tests before the paired samples t-test. The results of these tests were consistent and normal. Consequently, t-tests for paired samples might be used. The pretest and posttest statistical data are interpreted in Table 8 below.

Table 8. Statistics of results from pretest and posttest

Paired Samples Statistics					
Class	**Pair 1**	**Mean**	**N**	**Std. Deviation**	**Std. Error Mean**
Control Class (CC)	Pre-test	49.07	27	8.325	1.602
	Post-test	70.19	27	9.755	1.877

Experiment Class (EC)	Pre-test	50.34	29	8.857	1.645
	Post-test	76.03	29	10.297	1.912

Table 8 shows that the Control Class (CC) received an average score of 49.07 on the pretest and 70.19 on the posttest. On the other hand, the posttest averaged 76.03, and the Experimental Class (EC) averaged 50.34. These findings show that both manual and application-based learning increased student success. Table 9 below lists the noteworthy changes between each class's pretest and posttest. Before testing was carried out, the data obtained had fulfilled the test requirements, namely the normality and homogeneity tests.

Table 9. Significant differences between pretest and posttest in each class

Paired Samples Test								
	Paired Differences							
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
CC (Pretest-Postest)	-21.111	10.682	2.056	-25.337	-16.886	-10.269	26	.000
EC (Pretest-Postest)	-25.690	8.937	1.660	-29.089	-22.290	-15.480	28	.000

According to Table 9's study findings, CC's pretest and posttest scores were 0.000 (0.000 < 0.05). Additionally, EC's pretest and posttest both had a significance level of 0.000 (0.000 < 0.05). This indicates that learning success before and after traditional learning and application use differs significantly. A t-test between CC and EC is required to ascertain which kind of learning conventional learning or application-based learning is more successful. Table 10 explains the t-test findings between CC and EC.

Table 10. Results of the t-test between CC and EC

T-test test results between the Control Class and the Experimental Class			
Test	F	Sig.	Decision
Pretest	0.305	0.583	No Different
Posttest	4.746	0.034	Different

There is no discernible difference in the pretest results between CC and EC, according to Table 10's t-test findings between the two groups, which have a significance value of 0.583 (0.583 > 0.05). The posttest had the opposite result, with a significance value of 0.034 (0.034 < 0.05), suggesting that CC and EC had significantly different posttest outcomes. This result suggests that learning using the created application is more efficient than learning through traditional means.

Teachers' knowledge of pupils is greatly influenced by the learning medium they utilize [30][31]. In an attempt to raise the standard of learning, this study creates implementable learning materials. These mediums not only impart knowledge but also give students the opportunity to immediately explore, assess, and consider what they have learned. Additionally, it should be emphasized when using interactive media that learning will be more successful when information is delivered using both words and graphics [32][33]. Engaging learning materials will enhance students' comprehension of the subject matter. However, when conducting learning, one must consider additional crucial elements that support the learning process. Crucial components include infrastructure, relevant policies, teacher competence, and student learning preparedness [28][34][35]. The production of captivating educational materials may be aided by the expanding use of technology [36]. Students may practice automotive diagnostics or repair work using interactive media without worrying about equipment safety or damage. The core of the learning process, especially in vocational education, is experiential learning [37].

Developments in technology have a special ability to pique instructors' enthusiasm in using creative media [23][38]. When presenting instructional materials, educators must use creativity [39][40]. Additionally, they must be creative in creating educational materials that enhance the caliber of the learning process [41][42]. According to studies [43][44], effective learning materials are those that students readily accept and that enhance academic performance. In actuality, there are other factors than media use that affect student success. However, several variables influence student success. These elements include student internal circumstances, learning environment conditions, learning facilities and infrastructure, and instructor factors in instruction [42][45]. According to [46][47], the technical infrastructure's preparedness, the teacher's proficiency in handling the media, and the students' proficiency with the devices all have a significant impact on how successful interactive media is. As a result, the best possible use of interactive media requires both the availability of sufficient infrastructure and teacher training.

Students have the chance to comprehend the connections between learning resources from several sources thanks to integrated learning-based media creation in the automobile industry. Interesting educational materials may boost students' attention and help them learn [48][49]. Analysis of current demands in the sector informs the creation of interactive learning materials. If the application is easy for students to use, then interactive media is considered extremely practical [22][50]. Interactive media-based learning may enhance conceptual comprehension. Learning outcomes are dependent on how well teachers provide instructional materials [51][52]. Finding relevant topics and evaluating the learning materials are the first steps in designing learning. According to the criteria for choosing topics in integrated learning, the chosen subjects are relatable to students' everyday lives, straightforward, interesting, and current. Teaching materials are presented methodically, which encourages pupils to learn and think systematically. Through interactive media, students may better grasp the subject, which can enhance their cognitive abilities [53]. This illustrates how students may have meaningful experiences with interactive media.

Additionally, studies show that learning via created apps might affect vocational education students' performance. Following the implementation, learning results showed a larger improvement in the experimental group. Interactive application-based learning materials in this situation provide a more dynamic, visible, and responsive learning environment, which promotes students' active participation in the educational process. Students may conveniently and effectively access information and learning materials at any time and from any location with the help of the Android-based EMS learning application. Students' experience and knowledge may be further enhanced by taking quick exams and quizzes during their free time using mobile learning. Additionally, studies demonstrate that using Android mobile learning might improve learning efficacy. This implies that smartphone-based learning platforms have the potential to enhance learning via increased engagement and enjoyment. In particular, as we welcome the cyber-based Industry 4.0 age, mobile learning is the first step toward future digital learning. Educational institutions like instructors, lecturers, and teachers may employ Android mobile learning systems to provide digital learning notes and learning assessments [27][54][55].

4. Conclusion

Helping students envision the content they are learning is one of the goals of creating interactive multimedia. The creation and usage of interactive multimedia-based learning apps were evaluated favorably by media professionals, material experts, and application users based on a variety of criteria, according to this research. The application's interactive material has the potential to improve learning. While the study is going on, the application's impact on student learning accomplishment leads to higher learning achievement. In addition to helping instructors better communicate with their students, this application-based interactive media may boost student engagement in both online and offline learning environments. supported by user-friendly application-based learning materials that students may access on their own mobile devices. Suggestions for further study to optimize the learning process is interactive multimedia must be paired with certain learning models. In particular, to teach students how to think creatively and innovatively and solve problems so they are prepared to take on difficulties in the workplace.

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