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Development of Braking System E-Modules Chassis Automotive in Vocational High Schools

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ABSTRACT

This research is Research and Development (R&D) with the development of learning media in the form of braking system E-Modules on the material of drum and disc brake systems for students of the Automotive Light Vehicle Engineering Expertise Program at SMK Penerbangan AAG Adisutjipto Yogyakarta, using the ADDIE model (Analyze, Design, Development, Implementation, Evaluation) which consists of five stages, namely the analysis stage (Analyze), planning stage (Design), development stage (Development), implementation stage (Implementation), evaluation stage (Evaluation). Data collection techniques in this study were observation, interviews, and questionnaires. As for data collection instruments using expert validation questionnaire instruments and user questionnaires (students). The results of the validation of the feasibility of the Braking System E-Module learning media by material experts get an average percentage of the overall score of 77.65% with a good or feasible category. By media experts get an average percentage of the overall score of 81.18% with a very good or very feasible category. By user respondents (students) get an average percentage of the overall score of 85.40% with a very good or very feasible category. The conclusion of the development research shows that the learning media in the form of a Braking System E-Module is feasible to use in the learning process for Class XI Students at SMK Penerbangan AAG Adisutjipto Yogyakarta.

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Introduction

A country in creating development and progress requires high education to form a generation that is qualified in terms of education and expertise in order to achieve its goals. According to Article

3 of Law No. 20 of 2003 (Nasional, 2003) concerning the national education system, the purpose of national education is to develop the potential of students to become human beings who are faithful and devoted to God Almighty, have noble character, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens (Fauzi & Respati, 2021; Shabbir et al., 2022). Education is a process that is carried out consciously and deliberately to change human behavior both individually and in groups in an effort to mature humans through teaching and training (Harden & Laidlaw, 2020; Setiawan & Sofyan, 2022), where education for humans has a function to develop their potential, talents and abilities (Ahmad et al., 2023; Sariwulan et al., 2020). In this regard, education at each level, including at the vocational high school (SMK) level, must be organized in a systematic way in order to achieve these national education goals.

Vocational high schools (SMK) are a type of formal school that offers vocational education at the secondary education level as a continuation of junior high school, or other equivalent forms. Vocational high schools are part of the National Education System and focus on improving the ability of students to work in certain fields and gain the ability to adapt to the world of work (Khaharsyah et al., 2023; S. Purnomo & Triyono, 2018). In the majors at SMK, one of the existing majors is the light vehicle automotive engineering (TKRO) department. Light vehicle engineering is an expertise competency in automotive engineering that emphasizes the competency of mastering light vehicle repair services. This competency prepares students to work in maintenance and repair service jobs in companies or industries. At the SMK level, graduates are needed who are proficient and able to utilize the skills taught in order to utilize knowledge and skills when entering the world of work (S. Purnomo, Pamungkas, et al., 2023; Ratnawati et al., 2019). However, when education is implemented there is a difference between the results and the needs of society. This can be seen from the lack of readiness of SMK graduates when entering the world of work. Therefore, to ensure graduation, it is strongly influenced by the curriculum, teaching staff, learning process, facilities and infrastructure, school management, school environment and cooperation with industry (Maulana et al., 2021; Sutopo et al., 2020). Furthermore, the learning process should be supported by the development of learning media or teaching materials that are tailored to the characteristics of students and competencies.

Media is a tool to convey or provide messages in a learning process (Gani, 2022; Purnomo, Fatkhurahman, et al., 2023). Learning media is actually a way to convey information from communicators (teachers) to communicators (students), if the learning environment is designed in a systematic way, learning objectives can be achieved optimally (Handoyono et al., 2020;

Trishchenko, 2018). Learning media design can be adapted to the characteristics of students and follow digital developments, namely by utilizing conventional media or print media into electronic modules that are more interactive and more interesting. E-modules are the latest innovation from conventional or printed modules, where this e-module can be accessed through devices such as computers or cellphones and other software that supports access (Handayani, 2021; H. Purnomo et al., 2022; Zhou et al., 2018). E-module is an application used in the learning process in which it has methods, materials and assessments that are systematically made so that it can bring students to achieve competency goals (Handoyono & Hadi, 2018; Takko et al., 2020). E-modules are also defined as independent learning media arranged in digital form which aims as an effort to realize the learning competencies to be achieved, in addition to making students more interactive by using the application (Kuncoro et al., 2021; Rosyidi, 2020). The explanation, it can be seen that e-modules are media that are continuous with the teaching materials used in the learning process. In contrast to modules, e-modules are digital-based media while for the implementation of e-module learning can be accessed with devices such as cellphones and computers that support access.

Based on this, the researcher developed an E-Module Learning Media Braking System for Class XI Automotive Chassis Subjects at SMK Penerbangan AAG Adisutjipto. The author hopes that the development of this learning tool can help teachers in delivering material and help students to better understand how each component works in the brake system, and can also improve the abilities and knowledge of students, although not all of this knowledge can be remembered because the learning process there are several factors that influence learning activities.

Method

This type of research is research and development (R&D) using the ADDIE development model developed by Dick and Carry (Aldoobie, 2015a; Sari, 2017). The ADDIE development model has 5 stages, namely analyze, design, development, implementation, evaluation. The ADDIE development model is a learning design model based on an interactive system approach, the evaluation results of each phase can be used to direct the learning process to the next step (Aldoobie, 2015b; Ardianuari et al., 2022). The development carried out is the manufacture of braking system e-module learning media for automotive chassis subjects and knowing the feasibility of the product. This development research was tested on 20 students of class.

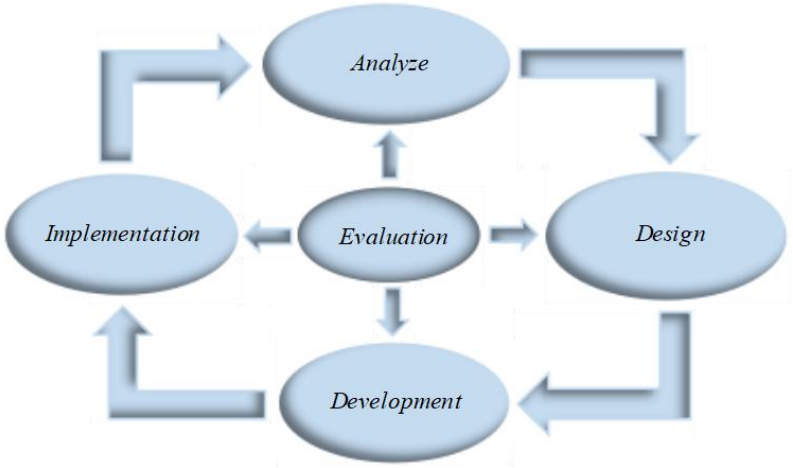


Fig 1: Development of ADDIE Model

This e-module development research uses three techniques in data collection, namely observation, interviews, and questionnaires. In research, data collection techniques are important things that are ways to obtain and collect data in research with the aim of obtaining data information and information related to research. As for the data collection instrument, this research uses a questionnaire instrument for media experts, material experts and users (students) to determine the feasibility of the braking system e-module media. The assessment results from expert validation were analyzed using a Likert scale with the categories "score 5 to strongly agree", "score 4 to agree", "score 3 to disagree", "score 2 to disagree", "score 1 to strongly disagree". To determine the validity and feasibility of the average total assessment score from the validation of media experts, materials and users (students) is calculated using the following formula:

$$\text{Presentation} = \frac{\text{Number Of Validation Sheet Score}}{\text{Maximum Score}} \times 100$$

The results of the data calculation using the formula above, then continued with the classification of the feasibility of e-modules in the following table:

Table 1. Clasification of E-Module Feasibility

Interval	Category
81% - 100%	Excellent
61% - 80%	Good
41% - 60%	Enough
21% - 40%	Less
<21%	Very Less

Result and Discussion

This e-module learning media development research uses the ADDIE development model. The development of this ADDIE model has five stages, namely analyze, design, development, implementation, evaluation. At the initial stage, namely the analyze stage, the analyze stage aims to analyze the requirements and feasibility of developing teaching materials and the needs required. For this reason, researchers conducted observations to identify the goals, needs, capacities, skills and characteristics of students. When observing in SMK, there are problems such as learning media modules, jobsheets and others that are used still using conventional media or printed media, learning processes that are not modern such as teachers who lecture and then students listen to make the learning process only centered on the teacher.

Teacher-centered learning is face-to-face learning where students still play a passive role because students are only limited to listening and seeing instructions delivered by the teacher, this is indicated by the results of 52.4% of students still below KKM. The diverse characteristics of students so that educators need learning media that is in accordance with the characteristics of students and the use of cellphones in the learning process. To overcome the existing problems, innovation is needed in learning media with the aim that it can support the teaching and learning process in the classroom and outside the classroom and can be used by educators to be used as a reference for teaching materials, this innovation is by developing e-module-based learning media.

The second stage is the design stage, at this stage the researcher designs the initial product. Making e-modules using existing applications on the device, namely using the canva application, in the canva application the e-module is processed from start to finish, namely (1) making the e-module cover, (2) choosing a page boundary frame that is adjusted to the color to make it look attractive, (3) compiling the contents of the braking system material, (4) compiling a summary, (5) making evaluation questions, (6) closing or ending the e-module such as compiling the author's bio and compiling other supporters. After the e-module has been completed, it is downloaded and transferred to the heyzine website so that it can be shared using a barqode or link from the e-module. On the heyzine website there are various features that are quite good, namely from the addition of videos, images, and so on that can be used anytime and anywhere with simulations suitable for use in learning (Bräker et al., 2023; Hasbi et al., 2020).

The third stage is the development stage, at this stage researchers continue the initial design with electronic media or from conventional media to electronic modules. There are several stages carried out by researchers in developing e-module media, which include: (1) making e-module

learning media by determining the material and design that can provide a new look so that the e-module learning media product looks more attractive, (2) conducting expert validation feasibility tests, namely by material expert validation, media expert validation and from user respondents (students) so that the e-module learning media can be said to be feasible or not. The product results of the braking system e-module development can be seen in the Figure 2 and Figure 3:



Fig 2: Automotive Braking System Electronic Learning Module



Fig 3: Material Content of Braking system E-Module

At this stage the development of e-module learning media is validated by material experts, media experts and users (students), material expert feasibility validation assessment by Mr. Samsul Hadi, M.Pd as Lecturer of PVTM UST study program, media expert feasibility validation assessment by Mr. Dr. Widodo, M.Pd as Lecturer of PVTM UST study program and from user respondents, namely students of class Xl TKRO SMK AAG Adisutjipto Yogyakarta. The results of the braking system e-module feasibility validation test from material experts get an average score percentage of 77.65%, from the braking system e-module feasibility validation test from media experts get an average score percentage of 81.18%, so that the conclusion from the validation test results by material experts and media experts is that the braking system e-module learning media is categorized as very feasible to be tested as media in the learning process for students that shown on Figure 7 and Figure 8.

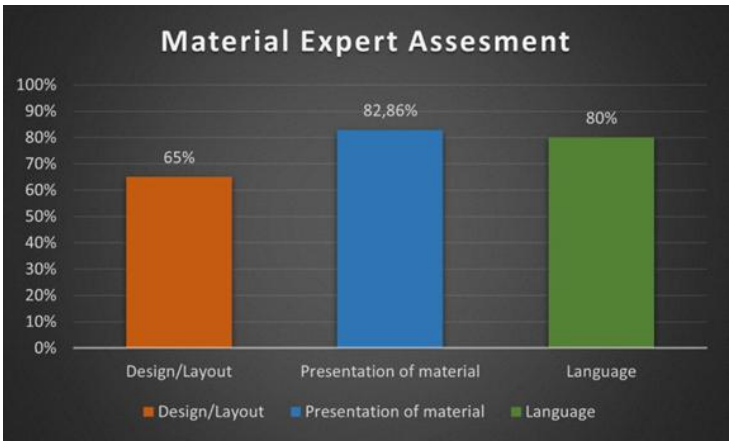


Fig 7: Material Expert Assessment

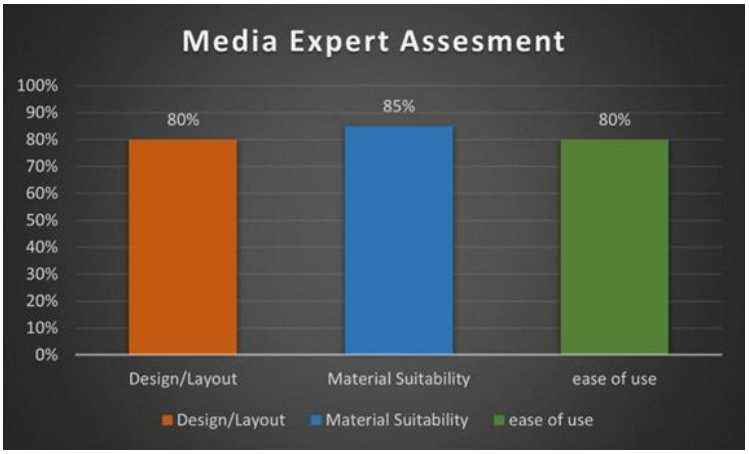


Fig 8: Media Expert Assessment

The figure above shows that the assessment of the material expert is seen from three aspects, namely from the design/layout aspect getting a percentage value of 65%, the material presentation aspect gets a percentage value of 82.86%, the language aspect is 80%. If the total percentage score of each aspect is summed up, it gets a percentage value of 77.65% with a decent category. Then the assessment of the media expert is seen from three aspects, namely from the design/layout aspect it gets a percentage value of 80%, the material suitability aspect gets a percentage value of 85%, the ease of use aspect gets a percentage value of 80%. If the total percentage score of each aspect is summed up, it gets a percentage value of 81.18% with a very feasible category.

The fourth stage is the implementation stage, at this stage what is done is to implement or apply directly the braking system e-module learning media product. The application or application of this braking system e-module is for class XI TKRO students of SMK Penerbangan AAG Adisutjipto Yogyakarta with 20 students. The application of the braking system e-module begins with distributing qr codes to students, for the initial process the researcher explains the e-module product first, followed by explaining the usage procedures and navigation buttons contained in the e-module. The application of this e-module product aims to determine the students' response to the braking system e-module learning media.

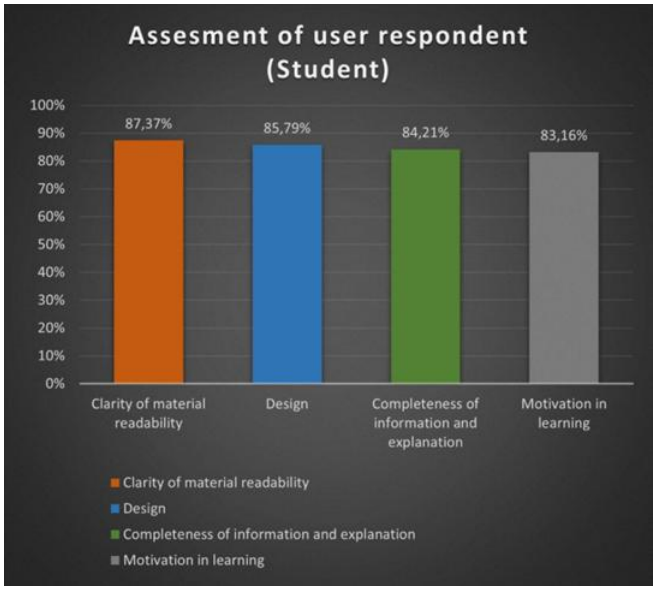


Fig 9: Assessment of User Respondents (Learners)

Based on the picture above, it shows that the assessment or response of students seen from four aspects, namely the clarity aspect of the readability of the material gets a percentage value of 87.37%, the design aspect gets a percentage value of 85.79%, the completeness aspect of the description and explanation (information) gets a percentage value of 84.21%, while the motivation aspect in learning gets a percentage value of 83.16%. If the total percentage score of each aspect is summed up, it gets a percentage value of 85.40% with a very feasible category.

Then at the last stage, the fifth stage is the evaluation stage. At this stage, researchers get criticism, suggestions and input from supervisors, material expert lecturers and media expert lecturers to make improvements to braking system e-module learning media products. These improvements are made so that e-module learning media products are more detailed and focused on learning outcomes, learning objectives and the flow of learning objectives, besides that the improvement of e-module learning media aims so that this e-module learning media can be used as a reference by teachers for learning activities in class and can also increase student independence in obtaining information or braking system materials in everyday life both in class and outside the classroom.

E-module learning media is a medium designed through the form of digital modules, in the module contains images, text and videos accompanied by navigation and attractive design so that it is feasible to use in the learning process (Guo et al., 2021; Herawati & Muhtadi, 2018). The advantages of e-module learning media are that e-module media can be accessed through software such as computers and cellphones and can be used anytime and anywhere so that it can facilitate educators and students in the learning process. In addition to the advantages of e-module learning media, it also has disadvantages such as the device used must be connected to the internet or can only be accessed online. To overcome this, e-module media can also be available in PDF but has limitations in appearance and navigation on the e-module.

Judging from the advantages and disadvantages, e-module learning media has significant benefits in the learning process for educators and for students. For educators, e-module learning media is an effective and structured media that makes it easier to deliver material and information. As for students, they are more helpful because e-module learning

media makes students learn more independently so that the learning process is better and easy to apply both in the school environment and outside school (Chiu et al., 2022; Gandasari et al., 2020; Hasan et al., 2020). Because of this, the development of class XI braking system e-module learning media at SMK Penerbangan AAG Adisutjipto can be used as a reference and tool for educators and students in the learning process. The goal is to create creative, active and innovative learning and encourage the involvement of students with the material presented by educators. This e-module learning media can also be used as an independent learning media for students both during the learning process at school and outside of school.

Conclusion

The research and development of this braking system e-module learning media, conclusions are obtained, namely: The product developed is a braking system e-module learning media that is presented using digital. In the e-module includes text, images and interesting videos so that it can be used as a learning resource for students and a reference for educators as teaching materials in the learning process. Then based on the results of the validation of the feasibility of the braking system e-module learning media by material experts, the average percentage of the overall score is 77.65% with a good category or "feasible". Based on the results of the validation of the feasibility of the braking system e-module learning media by media experts, the average percentage of the overall score is 81.18% with an excellent category or "very feasible". While the results of the validation of the feasibility of learning media by user respondents (students) get an average percentage of the overall score of 85.40% with a very good category or "very feasible". So it can be concluded that the braking system e-module learning media is suitable for use in the learning process.

Based on the explanation above, there are several suggestions for the utilization of braking system e-module learning media products, among others: (1) braking system e-module learning media products can be accessed through software such as computers and mobile phones, but can only be accessed through devices connected to an internet connection. (2) this braking system e-module learning media product can be used as a reference for educators as a tool for the learning process in the classroom and for students this e-module can be a reference for independent learning both at school and outside school.

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