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EFFECTIVENESS OF FLIP BOOK-BASED E-MODULE IN TEACHING BRAKE SYSTEMS AT SMK NEGERI 1 SAGARANTEN

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Abstract: This Study aims to develop a Flip Book-based E-Module as an interactive learning medium for the subject of Chassis and Power Transmission Brake Systems for Grade XI students majoring in Light Vehicle Engineering at SMK Negeri 1 Sagaranten, Sukabumi Regency. The development addresses the challenges of vocational education, which is still dominated by conventional methods and lacks instructional media capable of presenting technical content visually and engagingly. The research employed a Research and Development (R&D) method by combining the ADDIE and Dick & Carey instructional design models. The development stages included needs analysis, design, prototype development, expert validation, and limited trials with students. The validation results from subject matter experts, media experts, and instructional design experts showed that the developed E-Module is highly feasible for use, with respective validation scores of 92%, 93%, and 94%. Small- and medium-group trials also demonstrated positive student responses, with feasibility scores of 89% and 91%, respectively. Furthermore, the effectiveness test using pre-test and post-test methods indicated a significant increase of 55% in students' learning outcomes after using the Flip Book-based E-Module. These findings confirm that the Flip Book-based E-Module is not only feasible but also effective in enhancing the quality of vocational learning. The product is expected to serve as an alternative digital learning medium that supports the implementation of the Merdeka Curriculum. Additionally, this digital module has the potential to strengthen students' digital literacy and independent learning in the era of Education 4.0.

Kata Kunci: *Development, Digital Module, Flip Book, Brake System, Vocational School. Technical Education*

INTRODUCTION

The development of information and communication technology in the digital era has had a significant impact on the world of education, including in the realm of vocational education such as Vocational High Schools (SMK). Vocational education is required to produce graduates who not only have academic competence, but also practical skills that are in accordance with the needs of the industrial world. One of the main challenges faced in learning at vocational schools is the lack of relevant and interactive learning media to support the delivery of complex technical materials, especially in the automotive field such as in the subject of Chassis and Brake System Power Transfer.

Conventional learning media such as textbooks are often unable to explain technical concepts visually and dynamically. This has an impact on the low level of understanding and learning outcomes of students. To overcome these obstacles, the development of digital teaching materials such as Flip Book-based E-Modules is an innovative solution that is able to integrate text, images, audio, videos, and interactive quizzes in one interesting and accessible learning platform.

Flip Book-based e-Modules allow the delivery of material to be done interactively and flexibly, where learners can learn anytime and anywhere. Flip Books also offer a visual appearance that resembles a printed book with a digital edge, making the learning process more engaging and participatory. In the context of learning at vocational schools, especially in the Light Vehicle Engineering department, this module provides convenience in explaining technical procedures such as brake systems, with the help of animations, simulations, and applicable multimedia demonstrations.

Theoretically, the development of this E-Module is based on several important foundations. First, cognitive theory that emphasizes the importance of mental processes in information processing. In learning, students do not only receive information passively, but actively build knowledge through interaction with the material. Therefore, E-Modules designed with good visualization and structure will help strengthen memory and understanding of concepts.

Second, the multimedia theory developed by Mayer (2009), states that learning will be more effective if information is presented in various forms of media. Through a combination of text, images, sounds, and videos, students can more easily understand and remember the material presented. In the design and development stage of the development model, this theory is the basis for selecting the right media to be embedded in the E-Module.

Third, the constructivist theories of Piaget and Vygotsky support that meaningful learning occurs when learners are actively involved in building their knowledge through direct and contextual experiences. Flip Books as an interactive medium allow students to explore material, practice through simulations, and get direct feedback from the digital learning system used.

In this study, the development of Flip Book-based E-Modules was carried out using the ADDIE and Dick and Carey model approaches which included five systematic stages, namely: Analysis, Design, Development, Implementation, and Evaluation. This model was chosen because of its flexibility and completeness in producing learning media that is not only feasible, but also effective for use in learning.

By referring to the urgency of the need for innovative learning media, as well as existing theoretical and technological support, this study aims to develop a Flip Book-based E-Module that can improve the quality of learning in the subjects of Chassis Maintenance and Brake System Power Transfer. It is hoped that this module will not only improve student learning outcomes, but also become a reference for teachers in compiling digital technology-based teaching media that is in accordance with the development of the times and the needs of modern industry.

RESEARCH METHOD

This research uses a research and development (*R*&D) approach which aims to produce a product in the form of an innovative learning media, namely a Flip Book-based E-Module on the subject of Chassis Maintenance and Brake System Power Transfer at SMK Negeri 1 Sagaranten. The development model used is a combination of the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model and the Dick and Carey learning design model, which is adjusted to be more effective in the development of interactive-based digital media.

1. Research Design

The R&D method was chosen because it is suitable for producing and testing new learning products before they are widely implemented. The development stages are carried out systematically to ensure that the final product is valid, practical, and effective. The ADDIE development model provides a general framework for designing and developing learning media, while the Dick and Carey model places more emphasis on the formulation of detailed instructional objectives as well as the development of thorough formative evaluations.

2. Research Subject

The research subjects consist of:

- Subject matter experts, media experts, and learning design experts who provide product feasibility validation.
- Grade XI students majoring in Light Vehicle Engineering at SMK Negeri 1 Sagaranten as test subjects.
- The trial was conducted in two stages: small groups (6 students) and medium groups (12 students).

3. Development Stages

The development stages of Flip Book-based E-Modules are carried out through the following steps:

- Analysis: This initial stage involves analyzing the needs of students and teachers for interactive learning media, identifying learning difficulties faced by students, and studying basic competencies and indicators in the curriculum of the Light Vehicle Engineering Vocational School.
- Design: At this stage, the preparation of product design specifications in the form of E-Modules, determination of the Flip Book format, page navigation scenarios, media selection (text, images, audio, video), and the creation of user-friendly interface designs.
- Development: This stage includes creating an E-Module using the Flip PDF Professional software. The content is developed based on the curriculum structure, systematically arranged, and equipped with interactive multimedia. After the initial development is completed, validation is carried out by experts using assessment instruments that have been developed previously.
- Implementation: The revised E-Module based on expert input was then tested in small and medium groups. The use of E-Modules is carried out in real teaching and learning activities in grade XI, with teachers as facilitators.
- Evaluation: Evaluation is carried out through two approaches: (1) formative evaluation, namely through expert assessment and limited trials; and (2) summative evaluation, namely through student learning outcome tests in the form of pre-tests and post-tests to determine the effectiveness of the product.

4. Data Collection Techniques

The techniques used in data collection include:

- Observation: to find out the response of students when using the E-Module.
- Interview: conducted with subject teachers to get input on the relevance of the material and product implementation.
- Questionnaire: used in validation tests by experts and in assessing students' responses to the practicality of the E-Module.
- Learning outcome test: in the form of pre-test and post-test to determine the effect of the use of E-Module on improving student learning outcomes.

5. Research Instruments

The research instruments were developed according to the evaluation objectives, consisting of:

- Validation sheet for material, media, and learning design experts.
- Practical Quizzes for Students.
- Pre-test and post-test questions to measure effectiveness.

6. Data Analysis

- Qualitative data from interviews, observations, and expert input were analyzed descriptively.
- Quantitative data from validation and trials are calculated in the form of a percentage of eligibility score.
- The effectiveness of the product was analyzed using an increase in scores between pre-test and post-test. The effectiveness criteria are determined based on the category of improving learning outcomes according to educational media research standards.

CONCLUSION & SUGGESTION

The research resulted in a Flip Book-based E-Module that has gone through a series of stages of development and trials. The results of expert validation show that the E-Module is very feasible to use. The validation of material experts obtained a score of 92%, media experts 93%, and learning design experts 94%, all of which are in the very feasible category. This shows that the content, visual appearance, and instructional structure of the E-Module meet the criteria of effective learning standards.

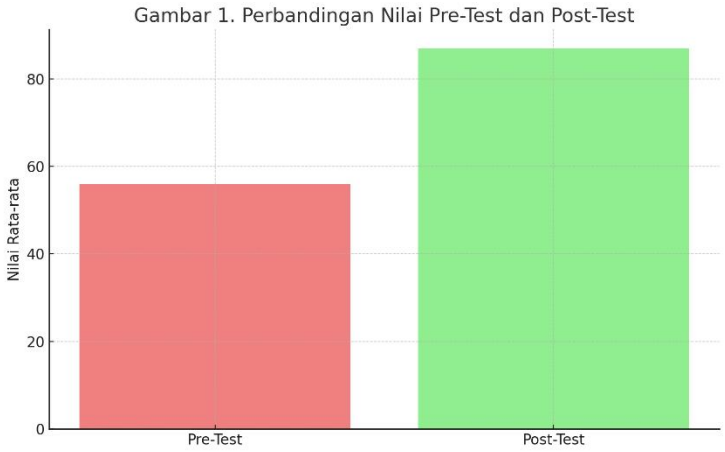
The trial was carried out in two groups, namely a small group with 6 students and a medium group with 12 students. The results of the small group trial showed a feasibility score of 89%, while the medium group reached 91%. Students stated that the Flip Book interface is attractive, navigation is easy to use, and the material can be understood faster thanks to the interactive visualizations and videos.

In addition, effectiveness tests were carried out through pre-tests and post-tests on students. The results showed an increase in learning outcomes by 55% after using Flip Book-based E-Modules. The average score of learners before the use of the module was 56, and increased to 87 after the use of the module. This shows that the E-Module is not only feasible by design, but also effective in improving students' understanding and learning outcomes in technical subjects.

Table 1. Results of Expert Validation of the E-Module

Expert	Aspects Assessed	Score (%)
Material Expert	Fit of content and KD	92%
Media Member	Visual design & interactivity	93%
Learning Design Expert	Structure & navigation	94%

Figure 1. Comparison of Pre-Test and Post-Test Results



Based on the results of the research that has been conducted, it can be concluded that

the development of Flip Book-based E-Modules is the right innovation in answering learning challenges in Vocational High Schools (SMK), especially in the subjects of Chassis Maintenance and Brake System Power Transfer. The development process carried out through the Research and Development (R&D) approach by combining the ADDIE and Dick & Carey models has resulted in valid, feasible, and effective digital learning products based on the results of expert feasibility tests and tests on students.

This Flip Book-based E-Module is able to bridge the limitations of conventional learning media, which has been less able to present learning materials visually and interactively. With the integration of multimedia elements such as text, images, animations, audio, and video, students can understand technical concepts more comprehensively. This is evident from the results of the pre-test and post-test which showed an increase in learning outcomes by 55%. In addition, students' responses to the E-Module were also very positive, both in terms of display, navigation, and understanding of the content of the material.

Validation from experts in materials, media, and learning design shows that this E-Module meets the feasibility standards in terms of content, instructional design, and visual display. The validation scores obtained are above 90% each, indicating that this product is very suitable for use as a learning medium. On the other hand, the positive response of students during the trial showed that this E-Module has high appeal and is able to increase their learning motivation.

Furthermore, the development of this E-Module is in line with the demands of the Independent Curriculum and the era of educational digitalization, where students are required to learn independently, flexibly, and contextually. The use of Flip Book as a digital learning platform provides space for students to explore material according to their respective learning paces, while strengthening technology skills that will be very useful when entering the world of work.

Thus, it can be concluded that Flip Book-based E-Modules are not only an alternative teaching medium, but can also be used as a technology-based digital learning model that is effective and relevant to the needs of the times. This module has the potential to be implemented more widely in other vocational schools, and can even be developed for a variety of other subjects that require a visual and high-practice approach.

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