

**DEVELOPMENT OF A PROJECT-BASED LEARNING INTERACTIVE E-MODULE FOR
BASIC AUTOMOTIVE COURSES AT SMK NEGERI 2 MEDAN**

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ABSTRACT

The development of learning media is highly demanded in the world of education, especially by utilizing increasingly sophisticated technology. This research produces e-learning modules using a valid, practical flip PDF application in Basic Automotive subjects. This research development model uses ADDIE (Analysis, Design, Development, Implementation, Evaluation). This research was conducted at SMK Negeri 2 Medan in class X with 36 respondents. Validation of media experts with an average of 93.75%, validation of design experts with an average of 95.50%, material expert validation with an average of 95.75% so that the media is very feasible to be tested. The teacher's response to the media is 92.00% and the student's response is 90.75%. So that it can be, the classical completeness of students reaches 97.22% which is included in the effective category. So that research on the development of interactive e-modules using a Project Based Learning (PjBL) learning model on automotive basics subjects in class X SMK N 2 Medan is declared valid, practical, and effective.

Keywords: Development; E-module; Project-Based Learning; ADDIE; Flip PDF.

INTRODUCTION

Education is a fundamental phenomenon that can influence individuals in developing their potential (Hidayat & Abdillah, 2019). According to the *Law of the Republic of Indonesia No. 20 of 2003*, Chapter 1, Article 1, Paragraph 1 on the National Education System, education is defined as a conscious and planned effort to create a learning atmosphere and learning process so that learners actively develop their potential to possess spiritual strength, self-control, personality, intelligence, noble character, as well as the skills needed by themselves, society, the nation, and the state. The success of education is strongly influenced by the effectiveness of the teaching and learning process. Efforts to improve the quality of teaching and learning can be made through several approaches, such as: (1) classroom management; (2) the application of appropriate learning models; and (3) evaluation of both the learning process and learning outcomes (Utama & Sukaswanto, 2020).

Vocational High Schools (SMK) are one of the formal educational institutions that aim to teach, educate, and train students to possess knowledge and skills in order to produce qualified and competent human resources in their respective fields (Rahmadani & Suryani, 2023). The study concluded that teacher competency development, as part of human resource management in vocational schools, must be carried out systematically and continuously, especially in the context of digital transformation in education. This includes: (1) teachers' mastery of various learning strategies; (2) openness to innovation and new insights; and (3) proficiency in science and technology (Hidayah et al., 2022).

The development of science and technology has had a major impact on education, particularly in the use of technology-based learning media. Learning media play a crucial role in the success of learning. They serve as tools containing learning materials designed to help achieve learning objectives (Setyobudi, Sofyan, & Komariah, 2024/2025). Besides learning media, the selection of appropriate learning models also significantly influences learning outcomes.

Based on observations and interviews conducted by the researcher, it was found that students experienced difficulties in understanding the subject *Basic Automotive Principles*, particularly in the topic of *automotive maintenance and repair*. This issue arose due to the lack of learning materials that could serve as reliable references for students, as well as the absence of suitable learning models applied by teachers. Therefore, the researcher concluded that it is necessary to develop a learning module integrated with technology, resulting in a product known as an E-Module.

An E-Module is an electronic version of a printed module that can be accessed via smartphones or computers. It can contain materials, objectives, methods, and evaluation procedures arranged systematically and attractively to achieve the desired competencies according to the level of complexity (Maryam et al., 2019). The learning model applied in this study is Project-Based Learning (PjBL). The use of the PjBL model provides educational benefits that can enhance students' academic achievement as well as soft skills, fostering effective interaction among learners and creating a conducive learning environment. The implementation steps of the module based on the PjBL model need to be further developed into a learning model that is valid, practical, and effective in achieving optimal learning outcomes. Astuti and Nurhayati (2021) state that the general steps of implementing the Project-Based Learning (PjBL) model are as follows: (1) Planning and Preparation, (2) Project Initiation and Organization (Launch Project / Set Up Project Work), (3) Project Implementation and Product Development (Doing the Project / Creating) (4) Presentation or Publication of Results (Presentation / Publishing), ND (5) Assessment and Evaluation.

Furthermore, Titu (2015) in his journal article explains that the stages of the Project-Based Learning (PjBL) process begin with the Planning stage. At this stage, the entire project is designed, which includes preparing the project, providing information, setting learning objectives, presenting real-world phenomena as problem sources, motivating students to identify problems, and preparing proposals. This stage also involves organizing teamwork, selecting topics, gathering information related to the project, making predictions, and designing investigations. The second stage is Creating, where students develop project ideas, combine the ideas that emerge within the group, and build the project. This phase includes development and documentation activities. During this stage, students produce a tangible product that will later be presented in class. The third stage is Processing, which includes project presentation and evaluation. During the presentation, students communicate their creations or findings from the group investigation, while in the evaluation phase, reflection, analysis, and assessment of both the project outcomes and the learning process are conducted. Based on the above explanations, it can be concluded that the stages of the Project-Based Learning (PjBL) model consist of six phases: (1) Identifying essential or fundamental questions; (2) Designing the project; (3)

Planning project activities; (4) Monitoring project progress; (5) Assessing project outcomes; and (6) Evaluating students' learning experiences.

RESEARCH METHODS

This research was conducted at SMK Negeri 2 Medan, specifically involving students of Class X TKR. The researcher employed a Research and Development (R&D) approach. In this study, the ADDIE development model was utilized. The ADDIE model, developed by Dick and Carey, aims to improve the instructional system. The model consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. Each stage of the ADDIE development model can be detailed as follows: analysis, design, development, implementation, and evaluation.

RESULTS AND DISCUSSION

Result

The result of this research and development is an interactive e-module for the subject *Basic Automotive Engineering* for Grade X students of vocational high school. The development model employed in this study is the ADDIE model, which includes the stages of Analysis, Design, Development, Implementation, and Evaluation.

Analysis Stage

The analysis stage is the phase in which the researcher identifies and examines the needs for an e-learning module in the *Basic Automotive Engineering* subject at SMK Negeri 2 Medan.

Design Stage

In the design stage, activities include creating the initial design of the e-module using Microsoft Word before it is converted into Flip PDF format. Image editing is carried out using Microsoft Word, and several images are sourced from e-books and Google in transparent PNG format.

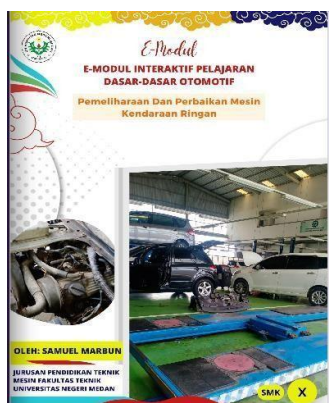


Figure 1. E-modul cover

Development Stage

At this stage, the process involves developing, organizing, and creating the interactive e-module. The process begins with compiling the learning materials, which are collected from various sources such as printed books, e-books, and journals. The researcher then prepares and develops a set of exercises and questions, which are independently designed by the author.

Implementation Stage

After the developed product has been validated by subject matter experts, design experts, and media experts—and revised accordingly—the next step is product testing with the target users. The implementation phase includes small-group trials involving 5 students and large-group trials involving 36 students from Grade X TKR at SMK Negeri 2 Medan.

Evaluation Stage

Evaluation is conducted throughout each stage of the media development process to validate the product. During this stage, the developed media is assessed for its quality to ensure its effectiveness and feasibility. The product evaluation is carried out by expert reviewers—one media expert (a lecturer) and one material expert (a lecturer and subject teacher).

Based on the assessment conducted by the media expert, the e-learning module received an average score of 93.75%, which indicates that the validated module falls into the “*Highly Feasible*” category. However, the expert suggested adding a project assignment to the module. The evaluation

from the design expert resulted in an average score of 95.50%, also categorized as “*Highly Feasible.*” Nonetheless, the expert recommended refining the layout by aligning images, enlarging text, and improving the color scheme. Furthermore, the material expert’s evaluation showed an average score of 95.75%, which also places the module in the “*Highly Feasible*” category. The expert, however, suggested removing the watermark from the e-module, as it could distract readers during the learning process.

Discussion

Based on the development procedure implemented in this research, the ADDIE development model was applied, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The outcome of this research is a learning e-module in the form of a link or website, created using Flip PDF, focusing on the topic of *Automotive Maintenance and Repair*. Based on the expert validation process, the media expert’s evaluation—conducted through questionnaires—showed a feasibility percentage of 93.75%, which falls into the “*Highly Feasible*” category. Although the e-learning module developed using the Flip PDF application was considered highly feasible, the expert suggested several improvements to further optimize its quality.

The design validation of the e-learning module, also conducted through questionnaires, obtained an average score of 95.50%, which indicates a “*Highly Feasible*” category. Similarly, the material validation process resulted in an average score of 95.75%, also categorized as “*Highly Feasible.*” Additionally, several test instruments—including pre-test and post-test assessments, each consisting of 20 essay questions—were validated by an expert to ensure their appropriateness for use in the study.

The implementation stage was carried out at SMK Negeri 2 Medan, where the validated e-learning module and test instruments were applied. The researcher collected feedback from both students and teachers through questionnaires to assess the practicality of the developed e-module. The student response questionnaire showed a total average score of 93.38 out of a maximum of 104, resulting in a practicality percentage of 90.75%, which is categorized as “*Highly Practical.*” The teacher response questionnaire obtained an average score of 92 out of a maximum of 100, indicating a practicality percentage of 92%, also categorized as “*Highly Practical.*”

During the implementation stage, pre-test and post-test assessments were conducted to measure the effectiveness of the learning media. The pre-test results showed that all 36 participating students were categorized as *not yet proficient* in completing the 20 essay questions related to the general learning objectives of the *Automotive Maintenance and Repair* topic. After learning with the e-module, post-test results indicated that 35 out of 36 students achieved mastery, with only one student not yet meeting the minimum criteria.

Based on the learning mastery analysis, as represented in the assessment results:

- The first learning achievement indicator reached 86%,
- The second indicator reached 84%, and
- The third indicator reached 78%.

These findings demonstrate that the developed e-module effectively supports students’ understanding and achievement in the *Automotive Maintenance and Repair* subject.

CONCLUSIONS

This research produced an e-learning module for Automotive Maintenance and Repair developed using the ADDIE model, which was proven to be valid, practical, and effective, as evidenced by high expert validation scores from media (93.75%), design (95.50%), and material experts (95.75%); the module’s practicality was confirmed through positive student responses (90.75%) and teacher evaluations (92%) after revisions based on expert feedback, while its effectiveness was demonstrated by a high level of classical student mastery (97.22%), achievement of learning objectives of at least 75%, efficient learning time comparable to conventional methods, and consistently positive student responses, indicating that the Flip PDF-based e-learning module is highly suitable for supporting project-based learning in automotive education.

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