

Development of a Diesel Engine Maintenance Textbook for Nautical Technology Students at West Sumatra Shipping Polytechnic

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ABSTRACT

This research focuses on the development of a structured and practice-based textbook for ship diesel engine maintenance aimed at Nautical Technology students at West Sumatra Shipping Polytechnic. The background highlights the increasing demand for skilled maritime workforce in Indonesia, contrasted with the lack of adequate teaching materials that combine theory and practice. The study aims to bridge this gap through a project-based learning approach. The method used is Research and Development (R&D) with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). Data were collected from students of the Nautical Technology study program and validated by two subject matter experts. Findings indicate that students had not been using proper printed resources and relied mostly on internet materials and lecturers explanations. The developed textbook received positive validation from experts with a score categorized as feasible with revision. Students' responses showed the textbook was attractive and effective in improving understanding and practical readiness. The research contributes to enhancing vocational education quality, strengthening the connection between theory and practice, and preparing competent graduates in maritime technology. It is concluded that the developed textbook is suitable for implementation with minor improvements, and further research is suggested to extend its application to other fields of maritime studies.

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1. INTRODUCTION

Indonesia is an archipelagic country that relies heavily on the maritime industry for transportation, trade, and economic growth. The increasing number of ships operating requires competent human resources, especially in ship machinery maintenance. Diesel engines are the most commonly used propulsion systems, and their maintenance is essential for ensuring ship safety and efficiency.

However, observations at Politeknik Pelayaran Sumatera Barat show that students of Nautical Technology often lack structured and practice-oriented textbooks. Most of them rely on internet materials, lecture slides, or verbal explanations from lecturers. This situation creates a gap between theory and practical understanding, which may reduce graduates' readiness to work in the maritime sector.

To address this issue, a diesel engine maintenance textbook was developed based on the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model. The purpose of this research is to produce a feasible and effective textbook that improves student learning outcomes, connects theory with practice, and contributes to maritime vocational education.

2. METHODS

a. Types of Research

This study is an educational research using a Research and Development approach, which is a process to develop and validate products in the field of education. This research is directed at developing an effective and relevant book for ship diesel engine maintenance.

b. Time and Place of Research

This research was conducted in 2025, at the Maritime Polytechnic of West Sumatra.

c. Data Sources and Data Collection Techniques

The data sources are everything that can provide information about the related research. The research data was obtained from several students in the Nautical Technology Study Program at the Maritime Polytechnic of West Sumatra for the 2024/2025 Academic Year and two expert validators in material development. The data collection technique used interviews to obtain information on the availability of books related to ship diesel engine maintenance at the Maritime Polytechnic of West Sumatra, especially for Nautical Technology students. A questionnaire was also used to test the feasibility and effectiveness of the developed book and to determine student responses to its use. In this study, secondary data were also used, such as laws, books, journals, and articles related to the research topic.

d. Research Procedure

This research procedure used the ADDIE model developed by William Lee. The ADDIE model consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model was chosen because of its simplicity, ease of implementation, while still considering the main principles of Research and Development (Lee, 2014).

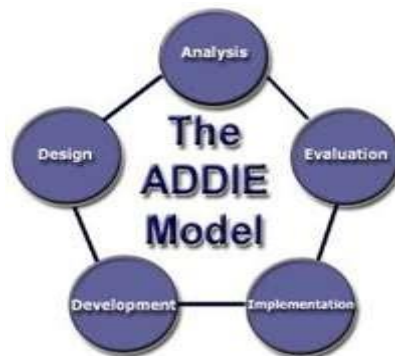


Figure 1. ADDIE Model

e. Research Instruments

The instruments in this research consist of three types: interview instruments, validation instruments for the developed book, and questionnaire instruments.

1) Interview Instrument

The interview instrument used was a structured interview focusing on the availability of books related to ship diesel engine maintenance at the Maritime Polytechnic of West Sumatra.

2) Validation Instrument

The validation instrument was used to assess the feasibility of teaching materials in terms of three aspects of assessment: 1) content feasibility, 2) presentation feasibility, and 3) language feasibility. These aspects were elaborated into 10 indicators and 24 assessment items. In addition, this instrument included some supporting questions to obtain suggestions and feedback for book improvement.

3) Questionnaire

The questionnaire was used to find out the students' responses to the use of the Ship Diesel Engine Maintenance book. The questionnaire instrument uses a Likert scale with a scale of 1 (Strongly Disagree), 2 (Disagree), 3 (Agree), and 4 (Strongly Agree). This questionnaire consists of three aspects which are described in 14 statements. In addition, this questionnaire is also equipped with a blank section for students to give comments, suggestions, or hopes for improving the Ship Diesel Engine Maintenance book.

f. Data Analysis Techniques

1) Analysis of Validation Data for Teaching Material Feasibility

The expert validation data on the feasibility of the developed book was analyzed by calculating the average score obtained using the following formula (Ria, 2019):

$$\bar{x} = \frac{\sum x}{n}$$

2) Analysis of Student Response Questionnaire Data

The questionnaire data on student responses to the use of teaching materials was used to determine the effectiveness of the materials or product. Effectiveness was analyzed using the same formula as the validation data analysis of teaching material feasibility (Ria, 2019).

$$\bar{x} = \frac{\sum x}{n}$$

3) Analysis of Interview Data

The interview data were analyzed qualitatively and descriptively to strengthen the information obtained through other methods.

3. FINDINGS AND DISCUSSION

a. Development Process

The development of the textbook followed the ADDIE steps. The analysis revealed that students did not use printed textbooks, relying mostly on online resources. The design process resulted in a textbook outline with 14 chapters, including diesel engine theory, maintenance procedures, troubleshooting, and practical case studies. The development phase produced a textbook draft of 150 pages.

b. Expert Validation

Table 1. Validation Results from Subject Matter Experts

Aspect	Indicator	Expert 1	Expert 2	Average
Content Feasibility	Completeness of material	4	4	4.0
Content Feasibility	Depth of material	3	3	3.0
Content Feasibility	Accuracy of concepts & data	3	3	3.0
Content Feasibility	Up-to-date examples	4	4	4.0
Presentation	Systematic structure	4	3	3.5
Presentation	Case examples	3	3	3.0
Language	Clarity of sentences	3	3	3.0
Language	Motivation and interactivity	4	3	3.5

Source: Research data (2025)

These results show that the textbook is categorized as *Feasible with revision*. The main suggestions were improving the depth of content and clarity of sentences.

c. Student Responses

Student feedback is summarized in Table 2.

Table 2. Student Responses to the Developed Textbook

Aspect	Indicator	Average Score
Appearance	Illustrations on the cover	3.00
Appearance	Diagrams and figures varied	3.09
Material	Clarity and completeness	3.09
Material	Logical and systematic sequence	3.17
Material	Helps understand concepts	3.30
Language	Easy-to-understand sentences	3.30
Language	Clear symbols and notations	3.09

Source: Research data (2025)

4. CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that:

- a. The Ship Diesel Engine Maintenance Book was developed using the ADDIE model. The details of each development stage are as follows:
 - 1) Analysis: identification of problems regarding the availability and feasibility of ship diesel engine maintenance books for Nautical Technology students, as well as needs analysis for compiling the book;
 - 2) Design: determination of objectives, design of format and structure, scope of material (breadth and depth), learning activities in the teaching material, and selection of references to be used. At this stage, subject matter experts were also designated as validators of the draft teaching material;

- 3) Development: drafting of the teaching material and validation process;
 - 4) Implementation: trial use of the draft teaching material in the learning process and collection of student responses regarding its use;
 - 5) Evaluation: evaluation and revision of the Ship Diesel Engine Maintenance Book based on student responses and expert validation results.
- b. The structure of the developed Ship Diesel Engine Maintenance Book follows the following format Teaching Material Cover; Preface; Table of Contents; List of Figures; List of Tables; Chapters (chapter title, material, scientific activities, competency tests); References.
 - c. The quality of the developed Ship Diesel Engine Maintenance Book is considered good. This is shown by the validation results of two subject matter experts, with an average score of 3.46 (Very Feasible – Expert I) and 3.17 (Feasible – Expert II). If viewed from the average score of each assessment aspect, the results were: content feasibility 3.39, presentation feasibility 3.33, language feasibility 3.17, and scientific aspect 3.38.
 - d. Student responses to the use of the scientific-based applied teaching material fall into the 'interesting' category. This is shown by an average student response score of 3.16, with an average score of 3.13 for the teaching material appearance aspect, 3.24 for the teaching material content aspect, and 3.20 for the language aspect.

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