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Development of applied technology textbook based on project-based learning from student's regional potentials

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Abstract—Vocational education fully contributes to the development of Human Resources through the graduates it produces. One strategy to improve student skills in the field of appropriate technology is to apply project-based learning from student's regional potentials. This study aims to produce valid, practical and effective textbooks as a tool to maximize project-based learning from student's regional potential. This research was conducted using research and development methods using the ADDIE model. The validity of the textbook was obtained from the expert assessment. The data on the practicality of the textbooks were obtained from the opinion of the lecturer in charge of the course and from 30 students who took the Applied Technology Machine course. The effectiveness of textbooks in terms of improving learning outcomes (pre-test and posttest). The results obtained from this research and development are that the textbooks are declared valid from the material and media aspects based on the assessment of experts, which are 88% and 84%, respectively. The textbooks were declared practical, the result of the lecturer's response was 86% and the student's response was 82.86%. Judging from its effectiveness, the textbook achieved a score on the Paired T Test of 0.000 which is smaller than 0.005 which indicates a significant difference between the pre-test and post-test or there is an influence on the difference in treatment given to research subjects.

Keyword: *Vocational, Textbook, PjBL, Regional Potential*

I. INTRODUCTION

The 21st century demands human resources who are able to adapt and take advantage of the sophistication of developing technology. Technology can be used by humans if they have the competence to operate it. Thus, the statement of competence can create creative, innovative, collaborative, competitive and comparative human resources can be justified (Yusliani et al., 2019). Facing the era of the industrial revolution 4.0 requires higher education institutions to prepare human resources, namely by increasing the competence of graduates who have skills according to the demands of the 21st century (learning and innovation skills) in addition to mastering science and technology in accordance with the fields they are involved in. Education in the 21st century, especially vocational education, is designed to create a productive young generation (Jalinus et al., 2019). Vocational education plays an important role in advancing the industry through competent graduates.

Intense market competition requires vocational education graduates not only to have the ability to be "able to work competently" but also to have the ability to create products that have innovation value (Syahril Syahril et al., 2019). Currently, vocational education is known as the dominant education in improving and developing psychomotor abilities. However, in line with the needs of the world of work in the 21st century, this concept must be changed that graduates from vocational education must have a balanced ability between thinking skills and technical abilities (Jalinus & nabawi, 2018). Technical and Vocational Education and Training (TVET) in the 21st century is not enough only for knowledgeable graduates, but also must be equipped with special skills (4C): such as Critical thinking and problem solving, Creativity and innovation, Communication

and Collaboration (Indarta et al., 2021). The skills possessed by graduates from vocational education are provisions to face the real world of work.

But in reality, there is a shortage of skilled workers in Indonesia. It is recorded that workers from vocational high school graduates are 11.82% and from higher education only 13.02% with details of university education at 10.23% and vocational education only 2.79% (BPS, 2020). From the data sourced from the Central Statistics Agency, it is known that there is an imbalance of human resources in the world of work in Indonesia. Indonesia needs more skilled workers to meet the industry which continues to grow every year. Vocational education that focuses on certain fields is a great hope to form skilled, innovative and adaptive human resources.

Vocational education must prepare a special strategy in solving these problems. One solution that can be done is to improve the learning model. The project-based learning model is able to form students' soft skills. Project assignments provide opportunities for students to apply their theoretically acquired knowledge to solve problems with critical and creative thinking skills (Kuppuswamy & Mhakure, 2020).

The Applied Technology course in the Mechanical Engineering study program at the Universitas Negeri Padang is one of the mandatory courses that provides opportunities for students to improve skills in the field of appropriate technology. The learning achievement in this course is that students have the competence to design appropriate technological machines. Previously, the task of designing a simple machine determined by the lecturer was less attractive to students which resulted in students being less active in completing assignments (Jalinus et al., 2017). Therefore, a project task-based learning model was designed from the potential of their region. The project task of the regional potential is a new learning model for vocational education (Syahril, 2020).

Through project assignments based on regional potential, students have more motivation because the machines made are useful for developing the potential of their area of origin (S. Syahril et al., 2021). This is supported by government regulations for village development, namely One Village One Product (OVOP) which aims to display the uniqueness or advantages of the area of origin that can increase regional income, develop human resources skills to create jobs (Ministry of Industry, 2022). To be able to make students learn independently in Applied Technology lectures, it is necessary to have a textbook that is used as a student handbook. Therefore, in optimizing the learning process in the Applied Technology course, the researchers developed a project assignment-based textbook from regional potentials designed using the regional potential model.

II. METHODS

A. Research Type

The type of research used is Research and Development (R&D). Research and Development is a type of research to develop a new or existing product (Sukmadinata, 2013). The implementation of research and development is carried out through the research method of one group pretest post test design (Quasi Experiment). This research was carried out using the ADDIE model developed by Dick & Carry (1996). ADDIE stands for Analysis, Design, Development Implementation, Evaluation which is also a development step that must be carried out systematically in research.

1) The analysis phase includes the need to collect information as material for developing products which consists of Learning Outcome analysis in the Applied Technology course, learning material analysis, and student characteristics analysis.
2) The design stage is the initial planning stage for textbooks that are adapted to the learning model used, namely project assignments based on regional potential.
3) The development stage is an activity to realize the textbooks set at the design stage. The developed textbooks were then validated by experts to assess the validity of the textbooks. Textbooks are validated by material experts and media experts using a questionnaire instrument.
4) The implementation stage is the application of textbooks to research subjects. Before the treatment was given, students gave a pretest as a comparison of student learning outcomes before using textbooks.
5) The evaluation stage is the final stage in the development of textbooks. The final test or post-treatment test was conducted to compare student learning outcomes after using textbooks (posttest). The final assessment includes a practical test and an effectiveness test.

B. Research Subject

The research subjects were students of the Department of Mechanical Engineering, Diploma 3 Study Program, Faculty of Engineering, Universitas Negeri Padang who took the Applied Technology course in the semester of January – June 2022 as many as 30 students.

C. Research Procedure

30 students who were in one class were taken initial data before treatment, namely pre-test. After that the textbooks that have been developed are applied to students for 7 weeks. Then, the post test was given at week 8 using the same instrument as the pre-test.

D. Research Instrument

1. Textbook Validation

Textbooks were validated using a questionnaire instrument. The validation instrument is filled with a Likert scale with answer choices for each question/statement item from 1-5.

2. Practicality of Textbook

The assessment of the practicality of textbooks was obtained through a questionnaire instrument filled out by lecturers and students. The questionnaire is filled with answer choices from 1-5.

3. Effectiveness Sheet

The instrument of the effectiveness of the textbook is in the form of test questions related to the applied technology learning material which is filled out by students in the tests carried out before and after the textbook is implemented.

E. Data Analysis Techniques

Data analysis in this research and development includes an analysis of the validity, practicality and effectiveness of project assignment-based textbooks from regional potentials. Data analysis techniques for each of the resulting data can be described as follows:

1. Validity Test Analysis

The validity of the textbooks was obtained through a questionnaire by experts and then analyzed using descriptive statistics with the Aiken's V formula.

2. Practical Test Analysis

Practical analysis is used with the percentage value (%) with the formula:

$$\text{Practical value} = \frac{Total\ Score\ Obtained}{Maximum\ Score}\ x\ 100\%$$

3. Effectiveness Test Analysis

The effectiveness test is done by comparing the situation before and after using the textbook. Effectiveness was assessed by pretest and posttest. The pretest and posttest values were tested for normality to assess whether the data were normally distributed or not. Analysis of the normality test using the Kolmogorov Smirnov test. After that, the textbook effectiveness test was continued with the Paired T-Test Analysis technique with the help of the statistical analysis application, namely SPSS.

III. RESULTS

The results of research and development of Applied Technology textbooks based on project assignments from regional potentials are as follows:

A. Validity test

Validation was carried out by 2 material experts and 2 media experts with the following results:

Table 1. Material Expert Validation Results

No.	Validator	Percentage (%)	Category
1.	Validator 1	90	Valid
2.	Validator 2	87	Valid
Mean		**88**	**Valid**

Table 1 is an assessment of the validity of the material from the material expert. Each material validator gives an assessment of the textbook for the Applied Technology Engineering course based on project assignments from regional potentials and gets 90% and 87% results, so that the average validity obtained is 88%.

Table 2. Media expert validation result data

Validator	Percentage(%)	Category
Validator 1	84	Valid
Validator 2	84	Valid
Mean	**84**	**Valid**

Table 2 is an assessment of the validity of the material from media experts. Validator 1 and validator gave their ratings of 84% and 84%, respectively. So that the average media validation obtained is 84% and is declared valid.

B. Practical test

Data on the practicality of textbooks were obtained from the responses of 1 lecturer and 30 students, with the following results:

Table 3. Practicality of lecturer response

Rating Indicator	Percentage (%)	Category
Compatibility of Textbooks with Materials	90	Very Practical
Ease of Use of Textbooks	86.67	Very Practical
Time efficiency	80	Very Practical
Mean	**86**	**Very Practical**

Table 3 presents the results of the practicality test of textbooks based on the responses of the lecturers of the Applied technology course with 3 assessment indicators, namely the suitability of textbooks with the material, ease of use of textbooks, and time efficiency with an average result of 86% or included in the very practical category.

Table 4. Student response practicality

Rating Indicator	Percentage (%)	Category
Ease of Use	84.83	Very Practical
Time efficiency	78.67	Very Practical
Usability	83	Very Practical
Mean	**82.86**	**Very Practical**

Table 4 presents data on the practicality of textbooks based on responses from 30 students who took the Applied Technology course with 3 indicators, namely ease of use, time efficiency and usability with an average result of 82.86% or very practical.

C. Effectiveness test

Table 5 is the result of the analysis of the normality test using the Kolmogorv Smirnof method with the help of the SPSS statistical program version 21. The normality test is useful for knowing the distribution of normal data or not provided that if the data significance value is greater than 5% or 0.05 then the data is said to be distributed normal. The results of the analysis of the normality test were 0.2 > 0.05, it was concluded that the data were normally distributed.

Table 5. Normality test

Kind of test	p-value	Description
Normality test	0.20	Normal

Based on the results of the t-test in table 6, the results of the t-test or a significant value of 0.000 (sig. 0.000 <0.05) are obtained, which means that textbooks have a significance or influence on learning.

Table 6. Paired T-test

Kind of Test	p-value
Paired T Test	0,000

IV. DISCUSSION

Based on the results of the research and development, it was found that students who studied the project task model based on regional potential using textbooks obtained higher learning outcomes. In this learning model with the assistance of textbooks, critical and creative thinking skills, problem solving and student communication skills are better. Students can plan and design appropriate technology machines based on the potential of their area of origin by using textbooks independently as a guide in completing project assignments.

This research is a reinforcement for previous studies, that practical and effective textbooks are used in project-based learning in vocational education. Research conducted by previous researchers showed the same result, namely textbooks made a significant contribution to vocational education (Kiong et al., 2012). The research and development of textbooks for applied technology courses based on project assignments from regional potentials is in line with the results of the design and development of 7 steps in PjBL learning by Nizwardi Jalinus which consists of 3 main steps, namely, 1) Skill Competences Debriefing, 2) Project Work, and 3) Evaluation (Jalinus et al., 2017).

This research and development have an impact on vocational education because the textbooks applied to the Applied Technology course use a project-based learning (PjBL) model which is very effective in improving various student competencies. With the applied learning model and the handbook in the course, students have the ability to identify and formulate problems, design projects based on the potential of their area of origin to solve real problems in their area of origin, and have the ability to make project proposals.

V. CONCLUSION

This research and development investigate the validity, practicality and effectiveness of the implementation of a textbook for applied technology

courses using a project assignment learning model from regional potential for mechanical engineering students of Faculty of Engineering, Universitas Negeri Padang. This research has implications for students and lecturers of applied technology to change the learning model that is in line with the objectives of vocational education which is required to produce graduates who have multi-competence according to the needs of the world of work. In this research and development, textbooks that are implemented in learning are proven to have a good impact on student learning outcomes. Textbooks are feasible, practical and considered effective in improving critical thinking skills and problem solving in planning and designing appropriate technology machines based on students' regional potential.

The limitation in this research and development is that the new textbook is intended for students of the Mechanical Engineering Department of Universitas Negeri Padang. Suggestions for lecturers of applied technology course to be able to use textbooks in the learning process to support students in planning and designing project assignments based on the potential of the student's area of origin. This textbook is also expected to increase students' motivation to learn independently in completing project assignments from regional potential.

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