Development Of Product Oriented Modules On Learning Building Materials For Civil Engineering Students

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Abstract: This study aims to produce learning modules that are valid, effective and practical for learning product oriented building materials. The type of this research is R&D using the ADDIE development model. The form of data is in qualitative and quantitative data obtained through questionnaires. Data analysis techniques used descriptive statistics and reliability testing using Cronbach alpha with SPSS. The results of the study indicate that the module developed meets the demands of validity based on expert judgment analyzed using the Aiken index coefficient. Module practicality is also fulfilled through positive responses from the lecturers and students as users. The ability of lecturers and students to produce products in the field of building materials is very good. In addition, student learning outcomes are included in the very satisfying category showing that the modules developed meet the effective criteria. Then the product-oriented module that is developed is feasible to be used for civil engineering students in an effort to improve students' cognitive abilities and skills.

Index Terms: product oriented module, development module, building materials, civil engineer.

1 Introduction

Technological advances have an impact on civil engineering that must be produced by higher education because education is the basic provision for developed and developing countries and has dignity in accordance with Law Number 20 of 2003 concerning National Education Standards. In this globalization era, special requirements are more for soft skills and supported by hardskill abilities. Building materials are very important knowledge to be mastered by civil engineering students because one of the factors associated with construction is built, if the material does not meet the requirements it will affect human life and cause cost loss for building owners. Concrete is one type of building material that is widely used today. Knowledge of concrete materials was studied in several subjects, one of which was concrete technology practices which were skills courses in various semesters in the Building Engineering Education Study Program, Diploma 3 on Civil Engineering and Undergraduate degree on Civil Engineering of Engineering Department of Building, Engineering Faculty of Universitas Negeri Medan. These skills will later be applied to the world of work. The world of work expects mastery in testing materials and being able to produce certain concrete. Higher education plays an important role in creating creative and productive students who can produce an innovation in industrial products, especially building materials. As illustrated in the KKNI level in Indonesia, that technical level or analytical group is at level 4 to level 6 (diploma level included at this level) and expert group levels have a level of 7 to level 9 (undergraduate level is included at level this). Skills, know-how, knowledge, and science vary in each level (Susanto & Suyatno, 2019). Civil engineering is one type of vocational education that has expertise in building construction.

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The taxonomy of the purpose of civil engineering education in the Engineering education book by John Heywood (2005) says that a technique must have the ability (1) design and conduct experiments and interpret data (consisting of designing, experimenting, analyzing and interpreting data); (2) identifying, formulating and solving technical problems. In today's modern development Yan.L. (2015) said that the characteristics of modern civil engineering are manifested in innovation in aspects of project planning, building materials, geological and foundation techniques, design techniques, construction techniques, ecology, intelligent building concepts and sustainable development concepts that will have a positive impact on civil engineering. So the purpose of this study is to produce a product-oriented learning module that can encourage civil engineering students to realize the characteristics of a modern civil engineering. The learning module is a learning tool that needs to be developed in accordance with the expected competency needs, so as to create students who are creative, innovative and entrepreneurial (Sarina, Kristiawan, & Wardiah, 2019).

2 Methodology

The research was conducted at Universitas Negeri Medan with research subjects of civil engineering students at diploma level 3 and undergraduate degree in the 2017/2018 even semester academic year of 40 people. The stages of module development use the ADDIE development model. The ADDIE model stands for Analysis, Design, Development or Production, Implementation or Delivery and Evaluations developed by Dick and Carry (2009).

2.1 Stage Analysis

The analysis process is a pre-planning stage that identifies product development needs in accordance with the goals of the learning objectives and students. At this stage also identifies learning content / material, learning environment and delivery strategy in learning by distributing questionnaires to validators, namely lecturers in the field of building materials in the field of engineering faculty of the state university.

2.2 Design Stage
The design process is carried out after the analysis data is obtained, then a draft product is designed according to the concept illustrated in the analysis phase. Product design is adjusted to the results obtained at the analysis stage so as to produce a new product. The product of this research is a module that has been developed. In addition, at this stage, it also designs instruments needed to validate products and test the effectiveness and practicality of modules.

2.3 Development Stage
The development process is carried out after the new product design has been completed. Then validation is done by means of expert judgment. Products are assessed by two validators who are considered experts in the field of building materials (practitioners from the world of work) and three validators who are experts in the field of learning through instrument sheets. Furthermore, the data is analyzed using the Aiken index coefficient.

2.4 Implementation Stage
The implementation phase is done by using a new product that is valid in learning or the real environment. At this stage begins with the test of students' initial knowledge before using the product and at the end of the use of the product tested the level of mastery of knowledge and skills through written test and assessment of lecturers of individual students through a validated instrument sheet. The implementation process also looks at the achievement of product development goals, interaction between students and product user feedback.

2.5 Evaluation Stage
The evaluation phase is carried out after all implementation data have been collected to measure the achievement of product development goals using descriptive statistics and reliability testing using Cronbach alpha with the help of SPSS.

3 Discussion and Result

3.1 Analysis Module Validity
The module validation process is carried out by expert judgment in a forum group discussion (FGD) using a valid sheet of instrument. The instrument validation sheet contains aspects of content eligibility (14 questions), construction aspects (9 questions) and language aspects (4 questions). Assessment is done using a Likert scale where the highest value is 5 (Very Valid) and the lowest value is 1 (Invalid). According to Aikens (1985) for values greater than or equal to 0.600 can already be interpreted as a Valid coefficient. The results of the FGD meeting obtained the following data in Table 1.

Table 1. *Module Validation Results*

Scope of question	Score V Aiken's	The Results of the assessment aspects
A. Eligibility of contents	0,825	Valid
B. Arrangement of book construct	0,861	Valid
C. Language /grammar	0,788	Valid
Average	0,825	Valid

The module product validation test results for the feasibility aspects of the contents obtained the V Aikens value of an average of 0.825 (Valid), the construction aspect obtained an average V Aikens value of 0.861 (Valid), and the linguistic aspect obtained a V Aikens score of 0.788 (Valid). As a whole the results of the product-oriented module validation test with V Aikens values averaged 0.825 which are categorized as valid.

3.2 Module Practicality Analysis
Practical analysis is reviewed by looking at whether the product is easy to use and whether the product can be easily understood during the learning process. Scoring uses a Likert scale with an answer criterion 1 representing a strongly disagree statement, answer 2 representing a disagree statement, answer 3 representing a doubtful statement, answer 4 representing an agreed statement and answer 5 representing a strongly agree statement. The module practicality sheet contains easy-to-understand aspects (17 questions) and construction aspects (7 questions). Data obtained as shown in Table 2.

Table 2. *Module Practicality Test Results*

Scope of question	Score V Aiken's	The Results of the assessment aspects
A. Ease of understanding	0,850	Practical
B. Arrangement of book construct	0,821	Practical
Average	0,836	Practical

The results of the module product practicality test for the easy-to-understand aspect obtained the V Aikens value of an average of 0.850 (Practical) and the construction aspect obtained an average V Aikens value of 0.821 (Practical). As a whole the results of the practical test of product-oriented modules with V Aikens values averaged 0.836 which are categorized as practical are used during learning.

3.3 Module Effectiveness Analysis
The effectiveness of a learning product is seen from student learning outcomes with minimum completeness criteria and standards in the good category. Assessment of learning outcomes using written tests and student psychomotor and affective assessment observation sheets. Data analysis for processing the results of learning outcomes assessment is done by statistical tests with tabulation techniques in determining the level of student learning achievement as respondents. Each respondent is said to be competent (complete) if it reaches an assessment score of ≥ 70% and a class is said to complete learning if in that class there are ≥ 85% of students who have completed their studies (Trianto, 2010: 241). Effectiveness assessment is done to interpret the results of the respondents' achievements using the category of effectiveness assessment as in Table 3.

Table 3. *Category of Effectiveness Assessment*

Percentage of achievement (%)	Category of Effectiveness
90 ≤ Score percentage ≤ 100	Very effective
80 ≤ Score percentage < 90	Effective
65 ≤ Score percentage < 80	Average
55 ≤ Score percentage < 65	Ineffective
Score percentage < 55	Very ineffective

Effectiveness test was carried out on respondents by dividing the pre-test sheet before the use of research products and then after the learning process took place a post-test was carried out. The summary of the written test results can be seen in Table 4. In addition, an assessment of the psychomotor aspects and the affective aspects of the students was conducted to determine the effectiveness of the product as a whole. A summary of the test results can be seen in Table 5.

Table 4. *Written test results*

Type of Test	Average score
Pre Test	62,50
Post Test	85,75

Judging from the results of written tests conducted it can be said that the level of understanding of students there is an increase after using this product-oriented module with an average of 85.75 included in the complete category.

Table 5. *Results of Assessment of Psychomotor and Affective Student Aspects*

No	Type of Test	Average rating score	Average score percentage of achievement (%)	Category of Effectiveness
1	Psychomotor aspects	43,62	82,30	Effective
2	Affective aspects	37,50	85,22	Effective

Judging from the results of tests on psychomotor aspects and affective aspects using a validated observation sheet previously obtained the average score of psychomotor aspects of 43.62 (82.30%) including the effective category and assessment of the affective aspects of students obtained a score of 37, 50 (85.22%) including the effective category.

4 Conclusion

The conclusion of this study is the development of product-oriented modules in learning materials that are valid, practical and effective for use by civil engineering students. Student learning outcomes show a complete and highly competent category. Furthermore, the affective aspects show a high level of discipline and student responsibility. In the psychomotor aspect shows the level of skill in using equipment and achieving the planned product targets also increases.

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