TEKNODIKA
e-ISSN: 2656-6621
http://jurnal.uns.ac.id/Teknodika

The Effectiveness of E-Modules Based on Problem-Based Learning toward Student Learning Outcomes in Educational Profession Courses

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Abstract: *The aim of this study is to develop an E-Module based on problem-based learning that enhances students' ability to solve problems critically and scientifically in professional education courses. The research method used is research and development, employing Rowntree's model, which includes three stages: planning, development, and evaluation. The planning stage involves several activities, such as: a) needs analysis, b) formulating general and specific objectives, c) creating an outline of content, d) conducting concept analysis, and e) determining the media and equipment. During the development stage, software tools will be utilized. However, Rowntree's model lacks a comprehensive evaluation phase, which is why it will be integrated with Tessmer's formative evaluation model. This collaboration will address Rowntree's limitations by incorporating Tessmer's more thorough evaluation process. Data will be collected through questionnaires and learning outcome tests. Tessmer's evaluation model consists of five stages: self-evaluation, expert reviews, one-on-one testing, small group testing, and field testing, with each stage assessed using a questionnaire. Frequent evaluations are expected to improve the results, and by combining both models, the goal is to produce a valid, practical, and effective module. The effectiveness of the E-Module based on problem-based learning is measured through pretest and posttest outcomes, with an N-gain of 0.76, which falls into the high category. These results indicate that the application of the E-Module based on problem-based learning has significantly improved learning outcomes, demonstrating its effectiveness for use in educational profession courses.*

Keywords: *E-Module, Problem-Based Learning, Development Research, Rowntree Model, Tessmer Model*

Abstrak: Tujuan dari penelitian ini adalah untuk mengembangkan E-Module berbasis problem based learning dan melatih mahasiswa untuk memecahkan masalah secara kritis dan ilmiah dalam mata kuliah pendidikan profesi. Metode penelitian yang akan digunakan adalah penelitian dan pengembangan. Model pengembangan yang diterapkan adalah model yang dikemukakan oleh Rowntree yang terdiri dari tiga tahap yaitu tahap perencanaan, tahap pengembangan dan tahap evaluasi. Tahap perencanaan dilakukan dengan kegiatan sebagai berikut: a) Analisis kebutuhan; b) Merumuskan tujuan umum dan khusus; c) Menyusun garis besar isi; d) Menentukan analisis konsep; e) Menentukan media dan peralatan. Pada tahap pengembangan produk akan dilakukan dengan menggunakan perangkat lunak. Akan tetapi, model Rowntree belum lengkap pada bagian evaluasi produk, oleh karena itu model ini akan dikolaborasikan dengan model evaluasi Tessmer sehingga ketidaklengkapan model Rowntree akan tertutupi oleh kelebihan model evaluasi formatif Tessmer. Teknik pengumpulan data dalam penelitian ini menggunakan angket dan tes hasil belajar. Model Tessmer memiliki lima tahap evaluasi yaitu self-evaluation, expert review; one-to-one, small group, dan field test, hasilnya akan dinilai dengan menggunakan angket. Semakin sering suatu produk dievaluasi maka hasilnya akan semakin baik, dengan kolaborasi kedua model ini diharapkan akan menghasilkan modul yang valid, praktis, dan efektif. Kualitas dan efektivitas E-Modul berbasis problem-based learning diperoleh dari hasil pretest dan posttest dengan N-gain sebesar 0,76 dengan kategori tinggi. Dari hasil

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tersebut menunjukkan bahwa penerapan E-Modul berbasis problem based learning di kelas mengalami peningkatan hasil belajar dengan kategori tinggi, sehingga dapat disimpulkan bahwa e-modul berbasis problem-based learning efektif untuk diterapkan pada mata kuliah profesi kependidikan.

Kata Kunci: Modul Elektronik, Pembelajaran Berbasis Masalah, Penelitian Pengembangan, Model Rowntree, Model Tessmer

Submitted: June 2024	Accepted: September 2024	Published: September 2024

INTRODUCTION

Learning is an inseparable part in realizing quality education. Learning is closely related to the definition of learning which is a process carried out by humans to obtain various things knowledge. Learning is a process of changing behavior that arises due to experience (Setiawan, et al, 2023), (Muzakkir, et al, 2019). This definition also contains the same meaning that learning is something changes in students' abilities and attitudes due to experience. Learning can be done anywhere, anytime and anywhere, but learning is carried out formally with lecturers and students interact with each other to process information so that the knowledge that has been carried out can be embedded to students.

The current learning process in educational profession courses in the Baturaja University Educational Technology study program still uses printed modules. This is still considered less effective and efficient. We need teaching materials that are able to make learning easier, such as technology-based teaching materials. The development of science, technology and information brings changes and new paradigms to learning material and learning method (Chomsum, 2020). Learning that uses information and communication technology can help educators in conveying material, and students in understanding the material being studied (Sakti, 2023).

Achievement of learning objectives can be seen from the increasing ability of students to master the material in educational professional courses. Abilities and skills can be developed through learning that creates a learning environment that is able to present problems to gain new knowledge and experience for students. Through problem-based learning, students can develop skills in posing and resolving complex problems, expressing opinions, increasing cooperation, increasing activeness, and developing the ability to analyze patterns and reasoning processes so that they can increase knowledge and skills.

From the problems that have been presented, it shows that the educational profession courses in the Baturaja University Educational Technology study program require information and communication technology-based teaching materials which are equipped with a problem-based learning approach in order to realize learning objectives and create independent and efficient learning. And don't forget, what is more important is that students are able to analyze and be able to provide solutions to problems faced in the learning process and their application in the real world, especially in the field of education.

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The educational profession courses require students to be able to think critically and be able to solve problems in learning. So we need teaching materials that are able to help students in independent learning. One of the teaching materials that is a solution to this problem is E-module. E-modules are teaching materials that are packaged systematically and interestingly so that they are easy to study independently. A good e-Module has the right approach so that it can be used effectively in learning. One approach that can be applied is approximation problem-based learning or often abbreviated as PBL.

The problem-based learning approach exposes students to authentic problems so that students can construct their own knowledge, develop higher skills, make students independent, and increase their own self-confidence (Hotimah, 2020). The problem lies within problem-based learning emphasizes real, unstructured problems (ill-structured) and is open as a context for students to develop problem-solving skills and build new knowledge. Problem based learning is a learning approach that has the characteristics of learning starting with giving a problem, and students are able to analyze it and are able to provide solutions to solve the problem.

E-Module based on problem-based learning is hoped that it can help in achieving the learning objectives and competencies of educational profession courses. The e-Module is designed according to student needs and is equipped with quizzes and assignments in the form of case studies on the material that has been studied to see whether the student has really mastered the material that has been studied before continuing to the next material.

Based on the explanation above, it is necessary to develop E-Modules based on problem-based learning in the educational profession course. With the results of this study, it also creates an innovation in the development of printed modules into E-Modules based on problem-based learning in the educational profession course. What distinguishes this study from previous studies is that the focus of this study is on the development of E-Modules based on problem-based learning in the educational profession course. It can train students to solve problems critically and scientifically, so that it can improve students' ability to solve problems and improve their learning outcomes. This aims to make students more active, independent, and creative in expressing ideas in learning and being able to solve problems that occur in learning.

RESEARCH METHODS

This study employs a Research and Development (R&D) approach (Sugiyono, 2019). The model adopted for this development is based on Rowntree's framework, which includes the planning, development, and evaluation stages (Rowntree, 1995). However, Rowntree's model is limited in its evaluation component. To address this gap, it is integrated with Tessmer's formative evaluation model, which enhances the evaluation process and complements the shortcomings of Rowntree's framework (Tessmer, 1988). The research procedure, which combines elements from Rowntree and Tessmer, is illustrated in the following figure:

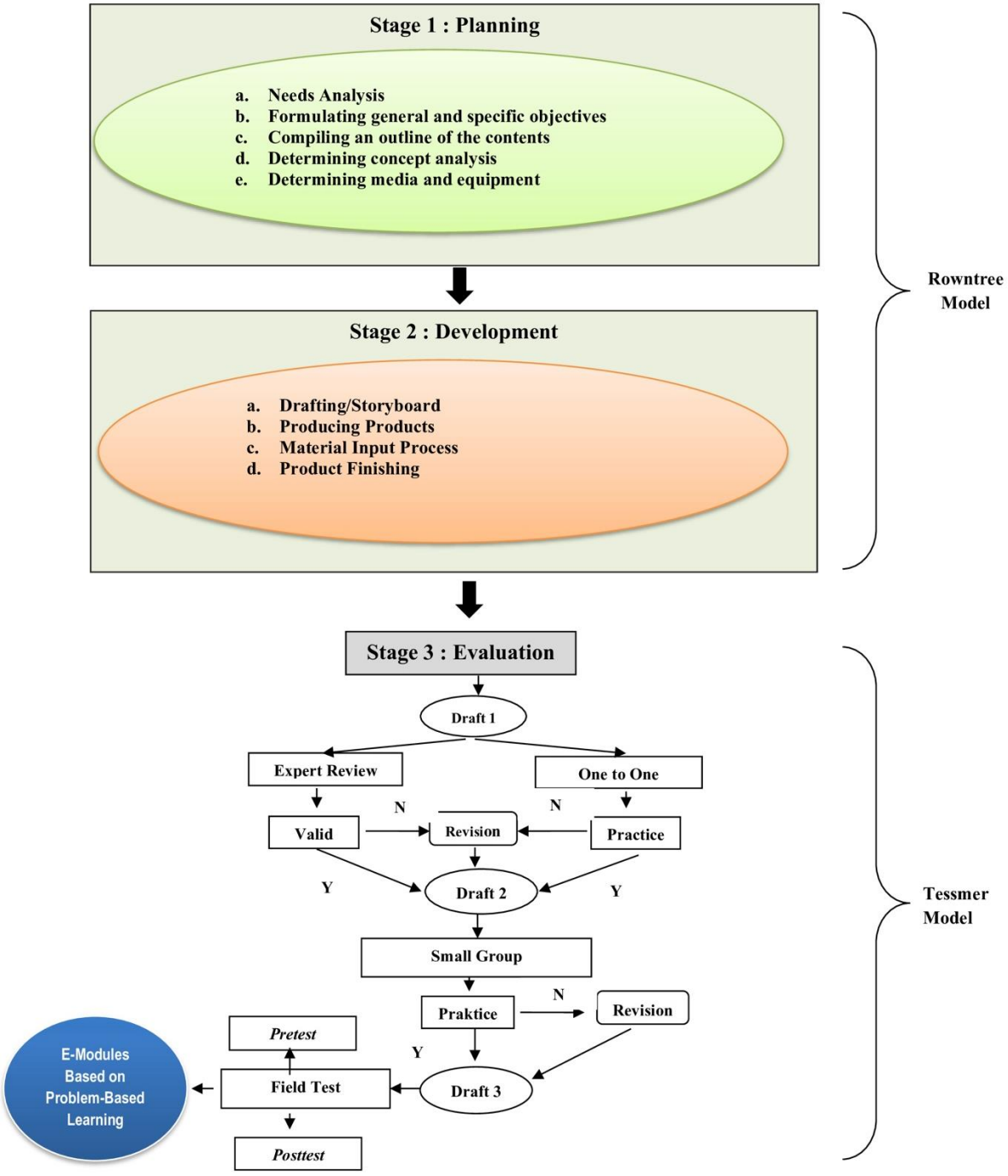

Figure 1. Research Procedure (Modification of Rowntree and Tessmer Models)

The research was conducted at the Educational Technology Study Program, Faculty of Teacher Training and Education, Baturaja University, South Sumatra. The data collection methods employed in this study include questionnaires and test results. The data analysis technique used is quantitative. During the descriptive/analysis phase of the study, the questionnaire data regarding student needs will be analyzed. The interpretation of the scores will be calculated based on the individual item scores and presented as percentages (Sudjana, 2016). The following formula will be used:

Index % = $\frac{Total\ Score}{Score\ Max}\ x\ 100$

Whether the quality of the E-Module based on problem-based learning is good or not can be used as a basis for whether it is suitable for implementation or not. In the learning outcomes test, the data is analyzed using Gain Score to determine the effectiveness of the E-Module based on problem-based learning that has been developed. The formula for the N-Gain test is:

N-Gain= $\frac{Post\ test - Pre\ Test}{Ideal\ Score - Pretest}$

N-Gain Effectiveness Interpretation Categories are as follows:

Table 1. Categories of Interpretation of N-Gain Effectiveness

Percentage (%)	Interpretation
<40	Ineffective
40 – 55	Less Effective
56 - 75	Moderately Effective
>76	Effective

RESULTS AND DISCUSSION

The stages carried out in this research include the planning stage, development stage and evaluation stage, as follows:

Planning Stage

This stage consists of several activities, namely: a) Needs analysis; b) Formulate goals general and special purposes; c) Prepare an outline of the content; d) Determine concept analysis; e) Determining media and equipment.

Development stage

The development stages consist of: a) Composing draf/storyboard; b) Producing products; c) Material input process; d) Finishing product.

Evaluation Stage

This stage consists of five evaluation phases, namely: a) self-evaluation; b) expert reviews, which include a design expert rating of 76% (good category), a material expert rating of 91% (very good category), a media expert rating of 80% (very good category), and a linguist rating of 85% (very good category); c) one-to-one evaluation, involving 3 students with different abilities (high, medium, and low), resulting in an average score of 83% (very good category); d) small group evaluation, involving 10 students, with an overall score of 86%; and e) field testing, involving a total sample of 30 students, with a final validation result of 83% (very good category), as shown in Table 2 below:

Table 2. Evaluation and validation test results

Validations	Score	Category	Result
Design Expert	76%	Good	Eligible
Material Expert	91%	Very Good	Eligible
Media Expert	80%	Very Good	Eligible

Linguists Expert	85%	Very Good	Eligible
One to One	83%	Very Good	Eligible
Small Group	86%	Very Good	Eligible
Field Test	83%	Very Good	Eligible

The results of this evaluation indicate that the E-Module teaching materials, based on Problem-Based Learning (PBL), are suitable for application in educational profession courses. Furthermore, the effectiveness of the E-Module, grounded in PBL, was tested to assess its impact on improving the learning outcomes of students enrolled in these courses.

The effectiveness of the PBL-based E-Module in educational profession courses was evaluated through a large group trial involving 30 students. At this stage, a pre-test was administered before the use of the E-Module, followed by a post-test after its application. Both the pre-test and post-test consisted of 20 multiple-choice questions administered during the fifth semester. The analysis of the pre-test and post-test results, reflected through the N-gain score, reveals the effectiveness of the E-Module. The N-gain value was calculated by first determining the average scores of the pre-test and post-test, and then applying the N-gain formula. The resulting N-gain value was 0.76, which falls within the "high" category. The detailed calculation of the N-gain value can be seen in the table below:

Table 3. N-Gaint Value Pretest - Posttest

	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
N_gain	30	,50	1,00	,7601	,18112
N_gain_Percent	30	50,00	100,00	76,0106	18,11170
Valid N (listwise)	30				

Based on the results presented in Table 3, the calculated N-gain value falls within the "high" category. This indicates that the use of the Problem-Based Learning (PBL) E-Module has a significant impact on improving learning outcomes. The high N-gain score demonstrates that the PBL-based E-Module developed for this study is highly effective in enhancing student learning, particularly in educational profession courses. These results suggest that the implementation of this E-Module can lead to substantial improvements in student achievement.

This research introduces significant changes in educational profession courses, shifting from traditional printed teaching materials to the use of a Problem-Based Learning (PBL) E-Module. An E-Module is a type of digital teaching material that incorporates text, images, or a combination of both. Previous studies have shown that, in addition to serving as a learning resource, electronic modules also function as a medium to stimulate independent learning and encourage students to read and study autonomously (Istiqoma et al., 2023; Laili, 2019). Moreover, electronic modules have been found to help improve students' academic achievement.

In the development of the E-Module, the instructor designs problem scenarios, provides clues and indications for additional reading, and offers guidance and resources necessary for students during their learning process. By focusing on problem-solving through PBL-oriented E-Modules, students are guided to solve problems independently, thus fostering the development of higher-order thinking skills, which in turn enhances their understanding of concepts (Kuusumasari, 2022; Purwaningtyas, 2017). The implementation of this approach allows students to build their knowledge through both learning experiences and social interactions, fostering a more meaningful learning environment. Furthermore,

PBL-based E-Modules have been shown to improve reflective thinking abilities (Suyoso & Nurohman, 2014; Suarsana & Mahayukti, 2013).

Several studies also indicate that PBL-based E-Modules facilitate better understanding of concepts and are effective in supporting learning (Hanria & Fauzan, 2023; Husniati, 2016; Hudha, Aji, & Rismawat, 2017). The structure of the E-Module developed in this study aligns with other similar research, including sections such as a cover page, foreword, table of contents, introduction, material description, evaluation questions, glossary, bibliography, and author's biography (Febriana & Sakti, 2021; Asiyah, Topano & Walid, 2021).

Problem-solving skills, which are key indicators of student learning, are assessed through the students' ability to understand the problem, plan solutions, execute resolution strategies, and draw conclusions (Pixyoriza, Nurhanurawati, & Rosidin, 2022). The main distinction of this study from previous research is the focus on developing a PBL-based E-Module specifically designed for educational profession courses within the Educational Technology study program. This research adopts a development model combining Rowntree's framework with Tessmer's evaluation model.

In conclusion, PBL-based E-Modules have proven to be valuable tools for helping students learn and enhance their problem-solving skills. By providing an opportunity for students to solve problems critically and scientifically, these E-Modules improve students' problem-solving abilities and their overall learning outcomes. Additionally, E-Modules offer the advantage of being accessible anywhere and anytime. However, the study also highlights a limitation: the E-Module is currently supported by only text, images, and problem examples. Future developments could benefit from incorporating more diverse multimedia elements, such as videos, animations, and interactive features, to enrich the learning experience further.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of data analysis that has been carried out in this research, it can be concluded that E-modules based on problem-based learning in educational profession courses to improve student learning outcomes are developed in planning, development and evaluation. Furthermore, the feasibility of the E-Module based on problem-based learning which has been developed based on expert assessments obtained an overall average score of 76% for design feasibility, 91% for material feasibility, 80% for media feasibility. 83% was obtained from the results of one to one student assessments, 86% was obtained from the results of small group validation and 83% was obtained from the results of the field test. The effectiveness of implementing E-Module based on problem-based learning can also be seen from the N-gain results of 76% in the very effective category. From these results, it can be concluded that the E-Module based on problem-based learning is feasible and effective to be applied in learning, especially in educational profession courses

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How to cite: Vidianti, A., Adesti, A., & Pebriantika, L. (2024). The Effectiveness of E-Modules Based on Problem-Based Learning toward Student Learning Outcomes in Educational Profession Courses. *Teknodika, 22 (2)*, 92-100. DOI: https://dx.doi.org/10.20961/teknodika.v22i2.93828