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The Effectiveness of Using Flipbook E-Module with Flipped Classroom-Integrated Problem-Based Learning Model on Student Understanding

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ABSTRACT

This study aims to evaluate the effectiveness of using the flipbook e-module with flipped classroom-integrated Problem-Based Learning (PBL) model in the Pharmaceutical Chemistry course. This e-module was tested on 20 students by comparing the results of the pretest and posttest using the N-Gain Score. The results showed that the e-module was able to increase the average understanding of students based on an increase in value from 51 (pretest) to 77.5 (posttest), with an average N-Gain Score of 0.55 which is included in the moderate category. These findings indicate that the e-module is quite effective in improving student understanding. The study recommends further development to improve learning effectiveness.

Keywords: E-Module, Flipped Classroom, N-Gain Score, Pharmaceutical Chemistry, Problem-Based Learning.

INTRODUCTION

The development of digital technology has become an inseparable part of human life, including in the field of education. One technology that is starting to be widely applied in the world of education is the e-module flipbook. The e-module flipbook is learning material presented in an interactive digital format. This flipbook allows students to access the material anytime and anywhere through digital devices such as computers, tablets, or smartphones. The main advantage of the e-module flipbook is its ability to present interactive, multimedia, and easy-to-understand content, so that it can help students understand the material better. As one of the digital learning media, e-modules can present material in an interesting way through text, images, animations, or videos, making it easier for students to understand complex material (Ramírez-Montoya et al., 2021; Rokhmania & Kustijono, 2021).

In addition to the use of e-module flipbooks, innovative learning models such as Problem-Based Learning (PBL) have also been proven effective in improving student understanding. PBL is a learning approach that focuses on solving real problems through collaboration and research. This model encourages students to think critically, creatively, and analytically in solving complex problems (Dolmans et al., 2016; Nurjanah & Mukarromah, 2021). When PBL is integrated with the flipped classroom concept, where students study the material independently before class sessions and class time is used for discussion and application, student understanding can increase significantly (Endaryati, 2022).

In addition, the integration of the flipped classroom model into PBL further strengthens the effectiveness of learning. Flipped classroom is a learning model that reverses the traditional paradigm. In a flipped classroom, learning materials are given to students before class sessions in the form of videos, e-modules, or other reading materials. Class time is used for discussion, collaboration, and problem solving. This approach allows students to learn the material at their own pace and come to class with a better understanding, ready to actively participate in discussions. Research shows that flipped classrooms improve student engagement, understanding of the material, and overall learning outcomes (Akçayır & Akçayır, 2018;

Rahman, Wibawa, & Nabila, 2021).

Previous studies have also shown that the use of flipbook e-modules with the PBL model integrated with the flipped classroom can improve student engagement and understanding. Interactive flipbook e-modules allow students to interact with the material in more depth, while PBL and flipped classrooms provide real contexts and practical experiences that enhance their understanding and critical thinking skills (Kumalasani & Eilmelda, 2022).

Thus, it is important to continue exploring and implementing innovative technologies in education, such as flipbook e-modules and integrated learning models, to improve the quality of learning and student understanding. This study aims to examine the effectiveness of using flipbook e-modules with the PBL model integrated with the flipped classroom on student understanding. In the context of learning Pharmaceutical Chemistry, materials such as "Drugs: Definition and Classification" often require innovative approaches to facilitate student understanding. However, research related to the effectiveness of using PBL-based e-modules in the flipped classroom model in this field is still limited, especially in Indonesia. Therefore, this study aims to evaluate the effectiveness of using PBL-based flipbook e-modules integrated with the flipped classroom model on student understanding. The results of this study are expected to contribute to the development of technology-based learning media in the digital era and become a reference for lecturers to implement innovative learning strategies in higher education.

METHODS

This study used a quantitative approach with a single group pretest-posttest design. This study involved 20 students who took part in learning using the Pharmaceutical Chemistry flipbook e-module in the Chemistry Department of Makassar State University. The instrument used in this study was a multiple-choice test consisting of 20 questions that were tested before (pretest) and after (posttest) learning. The pretest was conducted to determine students' initial understanding, then students studied the material using the flipbook e-module and finally the posttest was conducted to evaluate students' understanding after studying the e-module. After that, data analysis was carried out using the N-Gain Score based on the formula:

$$NGain\ Score\ (g) = \frac{\text{Postest} - \text{Pretest}}{\text{Maximum Score} - \text{Pretest}}$$

The results of the N-gain score obtained are then interpreted as follows the formula: (Hake, 1999)

Table 1. Criteria of N-gain score

N-gain Score (g)	Effectiveness Criteria
(g) > 0.7	High
0,3 ≥ (g) ≥ 0.7	Moderate
(g) < 0.3	Low

RESULTS AND DISCUSSION

The Pharmaceutical Chemistry e-module with Problem Based Learning (PBL) model integrated with the flipped classroom used in this study was applied to students of the Chemistry Department who programmed the Pharmaceutical Chemistry course through an online system, where students were given an e-module link that could be accessed using a smartphone or laptop using an internet network. This study was conducted offline by providing a pretest and posttest face-to-face in the classroom. Increased understanding is the variable measured in this study. Measurement of this variable is seen from the increase in the value of the pretest and posttest instrument work of students consisting of 20 questions. Based on the pretest and posttest data

from 20 students, the average pretest score, average posttest score, and average N-Gain score were obtained, which can be seen in table 2.

Table 2. Data on the results of the pretest and posttest of students

Total of subject	Average Pretest Score	Average Postest Score	Mean of N-Gain Score	N-Gain (%)
20	51	77.5	0.55	55.3

Based on the effectiveness criteria according to Hake (1999), the average N-Gain Score of 0.55 is in the moderate category ($0.3 \leq g \leq 0.7$). This shows that the use of e-module flipbook is quite effective in improving students' understanding of the material being taught and has the potential to support the teaching and learning process. However, there is still room for improvement so that its effectiveness can be increased to a high category.

Previous research by Kurniawati et al. (2022) showed that a more interactive e-module design can increase learning effectiveness to a high category. Our results are consistent with the research by Eryilmaz (2021) which showed that the flipped classroom approach significantly improves student learning outcomes compared to traditional learning models. In the study, students who learned through flipped classrooms with the help of digital media showed higher analytical skills and better understanding of the material. This is because flipped classrooms allow students to study basic material independently so that face-to-face time can be used for in-depth discussion and application of concepts. This approach is in line with the findings of Bishop and Verleger (2013) which showed that flipped classrooms increase student engagement in learning.

Furthermore, the integration of the PBL approach into the e-module also supports the results of this study. According to Huang et al. (2023), digital-based PBL not only improves students' conceptual understanding but also encourages critical thinking and collaboration skills. In the context of Pharmaceutical Chemistry learning, this ability is very important to prepare students to face the challenges of the world of work that require science-based problem solving.

However, compared to other studies, the average N-Gain score in this study (0.55) can still be improved. Research by Zainuddin et al. (2022) shows that the effectiveness of using flipped classrooms can reach a high category ($g > 0.7$) when students are given more structured study guides and additional materials such as interactive videos or simulations. Therefore, further development of this flipbook e-module, such as adding interactive elements and enriching materials, can improve learning outcomes.

In addition, the aspect of student learning motivation also needs to be considered. According to a study by Sun & Xie (2020), intrinsic motivation plays an important role in the success of technology-based learning. In this study, it is necessary to evaluate students' motivation while using e-modules to ensure that they remain motivated throughout the learning process. This study has several limitations, including a relatively small sample size (20 students) and limited time for the trial. The results of this study need to be retested by involving a larger number of students and a variety of courses to obtain more representative results.

The results of this study indicate that PBL-based flipbook e-modules with a flipped classroom model can be an effective learning medium to improve students' understanding. The practical implication is that lecturers can utilize this e-module as part of a technology-based learning strategy in the digital era. Overall, the results of this study provide a positive contribution to the development of innovative learning methods in higher education, especially in Pharmaceutical Chemistry courses. However, further research is needed to explore factors that can increase the effectiveness of using e-modules in learning.

CONCLUSION

This study about the flipbook e-module with a problem-based learning model integrated with the flipped classroom has successfully improved students' understanding in learning Pharmaceutical Chemistry, with a moderate category (N-Gain Score = 0.55). This e-module in the form of a flipbook has the potential to be implemented more widely with content

improvements to achieve higher effectiveness. In the future, it is expected to develop the e-module further with additional interactive features and conduct trials with a larger number of samples to obtain more representative results.

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