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## The Implementation of STEM-Based Lipid E-Book on Student Learning Outcomes

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### Abstract

The purpose of the study was to analyze the effect of using lipid e-books using the STEM approach on student learning outcomes. The method uses pre-experimental research with one group pretest posttest design. This research was conducted at one of the State Universities in Bengkulu with the subject consisting of 26 students who took the Organic Chemistry 2 course. The instrument used in this study was a multiple choice test with 4 meetings in the form of pretest and posttest questions. Data analysis techniques include the average value (mean), normality test, and hypothesis testing using a t-test using the SPSS for windows version 23 computer program. The results showed the average score of the learning outcomes before using the lipid organic chemistry e-book was 54.90, while after using the e-book the average value is 79.81. The learning outcomes data were normally distributed and the t-test value showed Significant (2-tailed) 0.00. These results indicate that the developed STEM-based teaching materials can improve student learning outcomes in particular and are able to improve the quality of learning for organic chemistry 2 courses in general.

Keywords: e-books; STEM; learning outcomes; lipids

### Abstrak

Tujuan penelitian untuk menganalisis pengaruh penggunaan e-book lipid menggunakan pendekatan STEM terhadap hasil belajar mahasiswa. Metode menggunakan penelitian pra eksperimen dengan desain *one group pretest posttest design*. Penelitian ini dilakukan di salah satu Universitas Negeri di Bengkulu dengan subjek terdiri dari 26 orang mahasiswa yang mengambil mata kuliah Kimia Organik 2. Instrumen yang digunakan dalam penelitian ini adalah tes pilihan ganda sebanyak 4 kali pertemuan berupa soal *pretest* dan *posttest*. Teknik analisis data meliputi nilai rata-rata (mean), uji normalitas, dan pengujian hipotesis menggunakan uji-t menggunakan program komputer *SPSS for windows* versi 23. Hasil penelitian menunjukkan skor rata-rata dari hasil belajar sebelum menggunakan e-book lipid adalah 54,90, setelah menggunakan e-book nilai rata-ratanya adalah 79,81. Data hasil belajar berdistribusi normal dan nilai uji t menunjukkan Signifikan (2-tailed) sebesar 0,00. Hasil tersebut menunjukkan bahwa bahan ajar berbasis STEM yang dikembangkan dapat meningkatkan hasil belajar mahasiswa khususnya dan mampu meningkatkan kualitas pembelajaran mata kuliah kimia organik 2 pada umumnya.

Kata kunci: e-book; STEM; hasil Belajar; lipid

## Introduction

Organic Chemistry 2 is a compulsory subject for Bengkulu University Chemistry Education students. This course has 3 credits (2-1) credits, with 3 credits of theory and 1 credit of practicum. This course describes stereochemistry, SN1, SN2 chemical reaction mechanisms, elimination, addition and several aspects that include components in living cells which include carbohydrates, amino acids, proteins and lipids. Based on the search for information with the lecturer in Organic Chemistry 2, the lecturer gave lectures with several learning methods and media. 1 Practicum credits are usually used for laboratory studies on materials related to Organic Chemistry 2. Based on interviews with lecturers, one of the materials that has a digital version is lipid material. This material consists of the structure, classification, source and function of lipid compounds and their applications in everyday life. Why digital books are important because in the 21st century, lecturers and students must be able to compete and adapt to technological developments as an effort to support Independent Learning-Independent Campuses. The efforts made include developing teaching materials, learning tools, evaluation tools, in digital form either using certain applications, or through learning platforms such as e.learning Unib, google classroom, edmodo, google forms, flash applications, professional pdf applications.

Digital books or e-books are a form of publication in the form of text, images, table, animation and video in digital form that are produced, published, and can be read through computers or other digital tools (Wahyuni & Rahayu, 2021). According to Subiyantoro, electronic books contain digital information that can contain text, images, audio or video, which can be read either on a computer, laptop, or smartphone (Subiyantoro, 2014). In contrast to printed books, digital books can present more interesting teaching materials and make learning more fun because they contain multimedia content in them. The English dictionary gives the term E-book to the

electronic version of the book. E-book is an abbreviation of Electronic book or electronic book, is a form of book that can be opened electronically via a computer. E-books have advantages over printed books which generally consist of a stack of bound paper containing text or text and or images. Digital books have the advantage that they can be disseminated more easily through media such as websites, virtual classes, email or other digital media. A person can easily become the author and publisher of his own book.

The development of the e-book is carried out using a professional flip pdf application which is very easy to use and apply. The Flip PDF Professional application is a flipbook maker application that has many functions and can edit pages. This application is able to create interactive book pages by including multimedia such as inserting images, videos from YouTube, MP4, audio videos, hyperlinks, quizzes, flash, and others. Among the e-module maker applications, the Flip PDF Professional application has more advantages, namely it is easy to use because it can be operated for beginners who do not know the HTML programming language (Seruni et al., 2019).

The teaching materials made in the form of an e-book use a STEM approach consisting of science, technology, engineering, and mathematics where the four elements are integrated with each other so that learning can be more meaningful (Sudirman et al., 2018). The STEM approach is an approach that links and integrates STEM subjects to create problem-based learning in everyday life so that it can train students to apply the knowledge learned on campus with phenomena that occur in the real world (Ariyatun, 2021). In the e-book presented is equipped with practice questions and final tests to measure student learning outcomes. Learning outcomes are changes in behavior that occur continuously and not statically after students take part in learning that can be measured or observed in the form of aspects of knowledge, understanding, habits, skills, appreciation, emotional, social relations, physical, character and attitude (Slameto, 2015;

Sudjana, 2013; Suhendri, 2011; Hamalik, 2013).

Previous research conducted by the team showed that the development of lipid e-books was feasible to be implemented on a large scale. Those are material expert validators with a percentage score of 93.33% and media experts with an average of 95.67% in the very feasible category (Handayani et al., 2022).

Based on the above background, researchers are interested in analyzing the effect of using lipid e-books using the STEM approach on student learning outcomes. This research is important because facing the 4.0 era, the need for digital-based teaching materials has become a necessity. Important components in teaching materials are also a concern as an effort to integrate several fields of Science, Technology, Engineering, and Mathematics that require students to think at a higher level, High Order Thinking Skills (HOTS).

## Method

This research is a pre-experimental study with a one group pretest posttest design, the experiment was carried out in one group/class without a comparison group/class. The aim is to compare student learning outcomes before being given treatment and after treatment or posttest. In this study, the treatment given was learning using a lipid e-book with the help of a professional flip pdf application. This research was conducted at a State University in Bengkulu. With the research subjects as many as 26 students who took the Organic Chemistry 2 course. The subjects used in this study were selected using the Purposive Sampling method. According to Sugiyono Purposive Sampling is a sampling technique with certain considerations (Sugiyono, 2012). The sample that will be taken as the subject of this research is taken with the consideration that it is located on the Bengkulu University campus and the class where the researcher teaches, and has facilities (supporting devices) to conduct online learning.

The instrument used in this study was a multiple choice test in 4 meetings with 10 questions at meeting 1, 10 questions at meeting 2, and 5 questions at meeting 3 and 4 each. The tests used in the form of pretest and posttest which aims to determine the ability of students before and after learning to use lipid e-books with the help of a professional flip pdf application. Data analysis techniques include the average value (mean), normality test, and hypothesis testing using t-test using the SPSS for windows version 23 computer program. Hypothesis testing is carried out to determine whether there are differences in student learning outcomes in organic chemistry lectures 2 before and after learning.

## Result and Discussion

The development of organic chemistry teaching materials 2 is carried out on lipid materials. The development of this lipid e-book uses a STEM approach. STEM-based learning is currently also becoming a trend in the field of education, this can be seen from several learning criteria from STEM it self Putri (2021), namely:

1. Engineering Design Process (EDP) is used to integrate science, mathematics and technology.
2. Standard-based math and science content, according to level and applicable.
3. Students regularly work in teams to plan, design, create prototypes or products, which are then tested and evaluated, and plans to improvise.
4. Students use a variety of communication approaches to describe challenges and present results.
5. The teacher facilitates inquiry-based, student-centered learning.
6. Failure is considered a natural part of the design process and an important step towards creating a successful solution.
7. Students are introduced to STEM careers and or applications in life.

# The Implementation of STEM-Based...

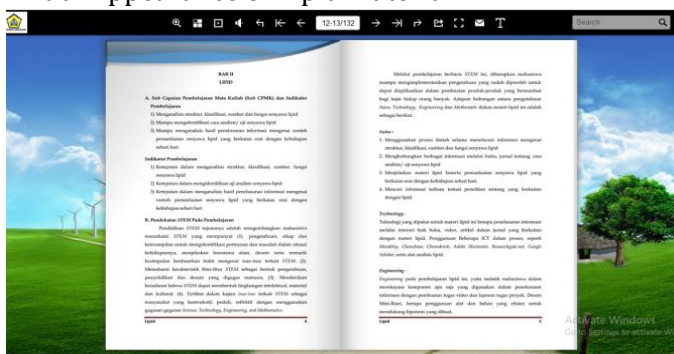
STEM-based organic chemistry learning is carried out with an effort to develop student abilities suitable for 21st century learning. The implementation of STEM in organic chemistry 2 lectures is shown in the learning activities of lipid applications in making VCO, purifying used palm oil, making red palm oil.

The application of STEM in e-books leads students to make a project in lipid application independently (Octaviani et al., 2020). This approach encourages students to be active in the learning process and develop scientific literacy skills because students are encouraged to be able to apply the organic chemistry concepts they learn on campus to solve problems in everyday life. With scientific literacy, students are expected to be able to apply their knowledge in everyday life with sensitivity and concern for their environment (Yuliati, 2017).

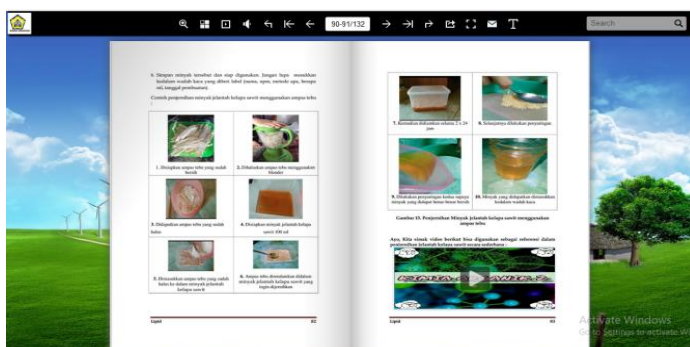
Evaluation of student learning is seen from the learning outcomes obtained by 26 students who take organic chemistry courses 2. In learning by using e-books. STEM-based by involving students to study independently before they study in class and when learning

in class students discuss in groups to discuss the material using e-books via smartphones/laptops. Students are given an e-book in the form of a link to be accessed online using a smartphone or laptop via the google chrome browser, besides that students are also given e-book files in (exe) and pdf formats so that students can access e-books offline via laptops. Learning activities are carried out online by asking questions through the WA group and the Zoom Meeting application. Students access the e-book, then carry out the learning process on lipid material with four meetings in class. Each meeting was given a pretest and ended with a posttest. In learning activities there is factual information from text (material) and videos, questions, discussion sheets that encourage students to know, understand and explain about lipids and their applications in everyday life. Learning activities are expected to help students understand the application of lipid concepts and applications both factually, conceptually, procedurally and metacognitively. Below is a display of the lipid e-book used in learning:

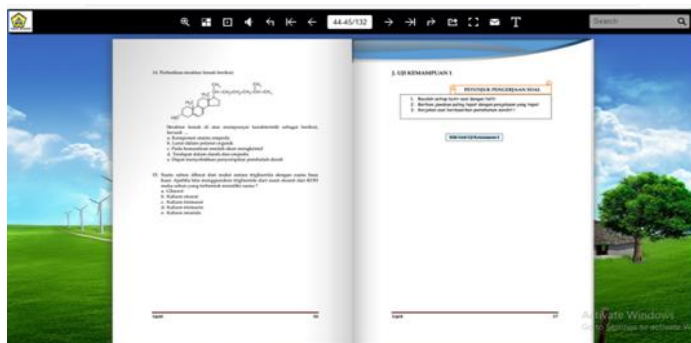
**Figure 1**  
Initial Appearance of Lipid Material



**Figure 2**  
Interactive Videos and Student Project Assignments on Lipid E-Books



**Figure 3**  
Display of Evaluation Link on the E-Book



With this e-book, it is easier for students to study lipid material. Students can read the material independently and can do the exercises in the e-book. The interactive videos in the e-book are very helpful in deepening the material about lipids. This is in line with previous research that the use of e-books can increase student interest in learning, learning outcomes with high criteria (Yulianti et al., 2019; Hasbiyati & Laila, 2017).

The learning videos displayed in the e-book also affect students' interest in

learning. With the video material, it is easier for students to understand, easier to convey by the teacher, interesting, and able to increase student learning motivation which can create a pleasant learning atmosphere and students do not feel bored during learning. (Ridha et al., 2021; Aliyyah et al., 2021; Maulani et al., 2022).

The following is the data on the pretest and posttest scores of students in large classes, which can be seen in Table 1.

**Table 1**  
Data Recapitulation of Students' Pretest & Posttest Scores

	Average	
	Pretest	Posttest
Score	54.90	79.81
N-gain:	0.55	

Based on Table 1, the average pretest value is 54.90, the posttest value is 79.81. An increase of 24.91, with an N-gain of 0.55 (including the medium category). The resulting e-book is then applied to the field/large class with the average student learning outcomes obtained.

The results showed that the STEM approach could improve the learning outcomes of chemistry education students taking organic chemistry courses 2. The analysis used was pre-experimental, namely comparing the data before and after treatment, in this case the learning outcomes before (pretest results) and after (pretest results) posttest) using a lipid e-book.

If the significance value  $> 0.05$ , then the data is normally distributed. Based on the results of normality, the value of sig (2-tailed) was 0.848. This means that the value  $> 0.05$ . it can be concluded that the residual value is normally distributed.

Based on the significant value (2-tailed)  $< 0.00$ . Less than 0.05 indicates a significant difference between the initial and final variables. This means that there is a significant effect on the treatment given. To find out whether there are differences in learning outcomes before and after treatment, a t-test was used using the SPSS program. Prior to the t-test, the data had been tested for normality by Kolmogorov-

Smirnov and the results showed that the pretest and posttest data were normally distributed (significance value 0.848, meaning that the value was greater than 0.05) and the t-test value showed Significant (2-tailed)  $< 0.00$ . less than 0.05, it means that there is a significant difference in learning outcomes before and after using the lipid e-book in fourth semester students of the 2020/2021 academic year who take organic chemistry courses 2. These learning outcomes show differences in student learning outcomes before and after treatment. The average score of learning outcomes before using the lipid e-book was 54.90, while after using the e-book the average score was 79.81. These results indicate that the e-book used is effective in improving student learning outcomes.

These results are in line with the research of NFH & Rahman (2020) that the application of interactive E-book teaching materials is effective in learning based on the average percentage of student responses to the use of E-book interactive teaching materials is 88.70% with very good criteria. E-books are also effective for use in independent learning, strengthening student character and learning outcomes (Wulandari et al., 2019; Damarsasi & Saptorini, 2018).

## Conclusion

These results indicate that STEM-based lipid e-books can improve student learning outcomes. The results showed that the average score of learning outcomes before using the lipid e-book was 54.90, and after using the e-book the average score was 79.81, with an N-gain of 0.55 (including the medium category). The learning outcomes data were normally distributed (significance value 0.848, meaning that the value was greater than 0.05) and the t test value showed Significant (2-tailed)  $< 0.00$ . less than 0.05, meaning that there is a significant difference in learning outcomes before and after using the lipid e-book.

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