Pedagonal : Jurnal Ilmiah Pendidikan
Vol. 07, No. 02, Oktober 2023, pp. 105~112
ISSN: 2550-0406, DOI: 10.55215/pedagonal.v7i2.6035

Implementation STEM-Based Flipbook Teaching Materials to Improve Students' Creative Thinking Skills

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Article Info

Article history:

Received Sep 8, 2023
Revised Oct 24, 2023
Accepted Oct 28, 2023

Keywords:

Flipbook
STEM
Creative thinking skils

ABSTRACT

This study aims to apply STEM-based teaching materials in the form of flipbooks to improve students' creative thinking skills. The method used in this study is the weak experiment method with a one group pretest posttest design. The research instrument used in the form of essay test questions and questionnaire sheets. Data analysis techniques include the assessment of creative thinking skills as measured using the N-Gain formula. The results of data analysis showed that students' creative thinking skills have increased with an N-Gain achievement of 0.42 (medium category). This indicates that STEM-based teaching materials in the form of flipbooks can improve students' creative thinking skills

Introduction

In implementing the 2013 curriculum, a scientific approach is a learning approach that emphasizes its use. Applying a scientific approach can improve the learning process in the classroom and help achieve learning objectives. The government hopes that using the 2013 curriculum can produce innovative, creative, and productive students through strengthening integrated skills, attitudes, and knowledge (Salamiyah & Kholiq, 2020). The scientific approach is a learning process that leads students to actively formulate principles or concepts through 5M steps which include observing, asking questions, gathering information, associating, and communicating. In order to make students able to carry out 5M activities, scientific approaches can be taken by starting learning with a phenomenon that can occur naturally or intentionally conditioned (Sudarisman, 2015).

In facing the 21st century, a scientific approach is an approach that is in accordance with the development of competencies needed in 21st-century learning. The 21st century is the century of knowledge because knowledge is the main foundation in all aspects of life. To face the 21st century, De Vito stated that the learning model needed in the 21st century is a learning model that seeks to develop a "sense of inquiry", scientific thinking skills, and students' creative thinking abilities. 21st-century learning emphasizes 4C skills, including creative thinking, communication, collaboration, and critical thinking. These skills must always be built because they are essential in industrial revolution 4.0. including one of them is creative thinking which requires students to produce something new or original. Creative

thinking involves the skills of originality, flexibility, elaboration, fluency, brainstorming, modification, imagery, and associative thinking. Creative thinking aims to improve divergent thinking skills and trigger curiosity (Kustijono & Wiwin HM, 2014). Creative thinking requires students to be able to solve problems, have a variety of answers, master the concept of problems, and communicate ideas or ideas on a problem topic. Therefore, creative thinking skills are skills that need to be mastered by students in the 21st century. Creative thinking can affect learning outcomes because student learning outcomes are influenced by understanding a concept and the ability to solve problems during the learning process (Nugrahaeni et al., 2017).

The learning needed so that students can survive in this era of globalization is to increase creative thinking skills. Bybee claims that STEM-based learning is feasible to use in this era of globalization because each STEM discipline can train students to communicate, collaborate, think at higher levels and provide creativity as the 21st-century demands (Halimatul & Aripin, 2019). In facing the challenges of the 21st century, STEM is the right learning approach used in the 21st century. The four disciplines in STEM are a combination that is needed simultaneously, which aims to solve problems in the learning process; other than that, STEM-based learning is able to build an active learning system. STEM learning teaches students how to understand science concepts and relate them to life so that in the learning process, students do more than just memories concepts. In implementing STEM-based learning, students are trained to hone cognitive abilities, improve their creative thinking skills with the help of technology, and apply knowledge (Octaviyani et al., 2020).

The development of creative thinking skills can be done by using teaching material that suits the needs of students. Therefore, we need supporting teaching material that is able to facilitate the development of student's creative thinking skills, one of which is a STEM-based Flipbook. Flipbook is a book with a shape resembling an album in which there are learning materials arranged in attractive colors (Nuryani et al., 2021). Flipbook is an interactive electronic book that has several advantages; namely, it can contain video, animation, and sound files. This flipbook is useful for students because it can make it easier for students to study independently and can increase student motivation in learning (Taukhid, 2022). The use of flipbooks as one of the Electronic School Books is seen as capable of producing interesting and conducive learning activities. Learning using flipbooks is expected to provide updates in classroom learning. Flipbooks do not only contain text but also images, animations, audio, and videos that can make it easier for students to learn. Flipbooks can also be studied independently by students so that these Flipbook teaching materials can improve student learning outcomes and thinking skills (Wardani, 2021).

Flipbooks based on Science, Technology, Engineering, and Mathematics (STEM) are digital teaching materials that connect aspects of science, technology, engineering, and mathematics. Through STEM learning, it is expected to produce human resources who can reason, think critically, logically, and systematically so that they can face global challenges in the future (Sari, 2021). Started that the educational process in the current era of information and communication technology helps optimize learning by developing STEM-based digital teaching materials (Nugraha, 2022). In the research of Cahaya Rancamaya Islamic Boarding School, the teaching materials used are in the form of printed books containing biological content without any STEM elements. Even though in the current Covid-19 pandemic, digital learning media are needed that are made with the principle of independent learning. One of the digital media that is good and easy to use is digital teaching materials. Teaching materials that are integrated with technology and applications also raise

curiosity in engineering technology and the concepts being studied. Hikmawati et al. (2020) conducted a study showing that digital teaching materials such as flipbooks can improve STEM literacy. Research by (Cahyani et al., 2020) also shows that STEM-based teaching materials can improve students' thinking skills. Therefore, this study aims to apply STEM-based teaching materials in the form of flipbooks in order to improve students' creative thinking skills.

Method

The method used in this study is the weak experimental method with a one-group pre-test post-test design (Table 1). The subjects in this study were class XI MIPA 2 Cahaya Rancamaya Islamic Boarding School. This research starts from August 2021 to December 2021.

Table 1. Research design

Pretest	Treatment	Posttest
O_1	X	O_2

The biological material in the flipbook that is compiled is the respiratory system material. The STEM features contained in the flipbook include aspects of science, technology, engineering, and mathematics contained in each sub-chapter of breathing material. The instruments used in this study were essay test questions to measure creative thinking skills and a questionnaire sheet to determine teacher and student responses to flipbooks. Data analysis techniques include the assessment of creative thinking skills, which are measured using the N-Gain formula (Rudibyani, 2019). Testing using the Gain value is carried out to measure improvements in student learning outcomes. N-Gain has certain criteria (Solihudin JH, 2018).

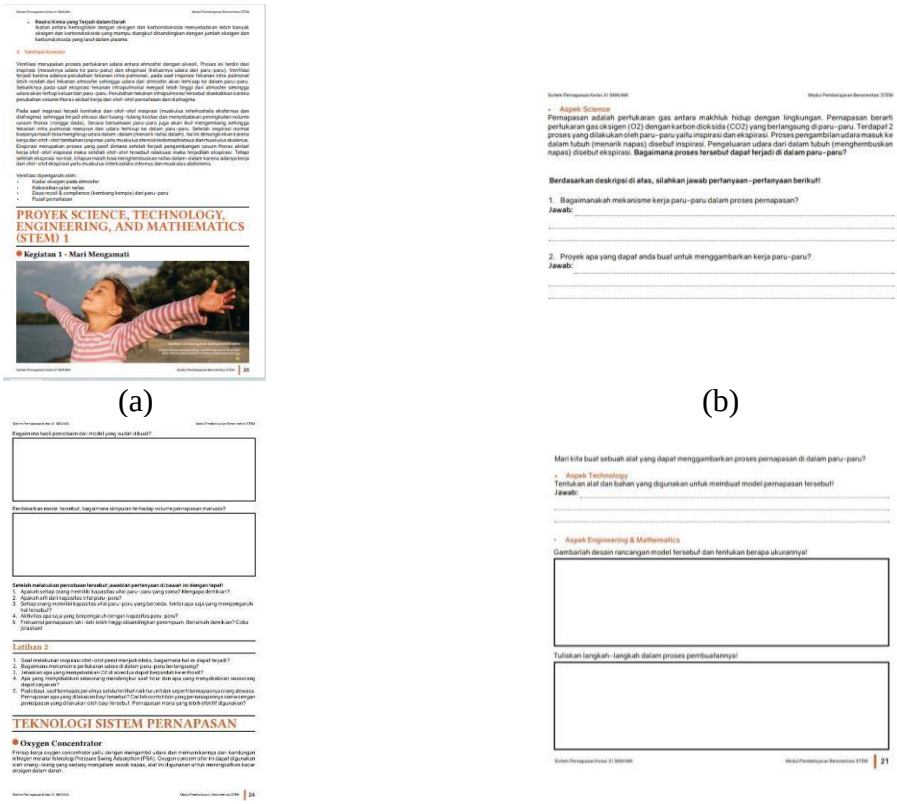
$$N - Gain\ formula = \frac{\text{posttest score} - \text{pretest score}}{\max score - pretest\ score}$$

Table 2. N-Gain value criteria

No	N-Gain Score	Criteria
1	*n-Gain* ≤ 0,3	Low
2	0,3 ≤ *n-Gain* ≤ 0,7	Medium
3	*n-Gain* ≥ 0,7	High

Results and Discussion

The developed flipbook is divided into 3 sub-chapters: structure and function of the respiratory system organs, respiratory mechanisms, and disorders of the respiratory system. The STEM features in the flipbook include science features, technology features, and engineering and mathematics features in figure 1. The following is a display of a STEM-based flipbook.



(a) (b)

(c) (d)

Figure 1. STEM-based flipbook display
(a) STEM project 1, (b) Science features (biological material), (c) Technology features (useful technology on the respiratory system), (d) Engineering & math features(making projects and measuring tools and materials)

This effectiveness test was conducted to determine the effectiveness of STEM-based flipbooks in improving creative thinking skills. Testing the effectiveness of flipbooks in improving creative thinking skills was carried out on 15 students of class XI in the first semester. Data collection in this effectiveness test was carried out by implementing STEM-based flipbooks. This flipbook is used by students independently and in 2 meetings in 1 week during the learning process. The learning process took place 2 times online through the zoom platform. In the learning process, students were first given a pre-test to measure their creative thinking skills before using flipbooks. It was followed by reviewing the material and compiling a project on the respiratory system. Then at the second meeting, the students were asked to present the results of the projects they had done, and at the end of the lesson, a post-test was conducted to measure students' creative thinking skills after learning using STEM-based flipbooks.

The pre-test and post-test results were tested to measure students' creative thinking skills that were analyzed using N-gain. The questions presented in the form of essays amounted to 3 items regarding the issue of smoking among teenagers, and students were asked to design ideas for solving these problems. The results of the pre-test and post-test analysis of students' creative thinking skills can be seen in table 3.

Table 3. The results of pre-test and post-test analysis

No	Data Implementasi	*Pretest*	*Posttest*

1	Total students	15	15
2	Maximal value	56	89
3	Minimum value	11	33
4	Average value	38,4	63,8
N-gain		0,42 (Medium)	

Based on table 3, it can be seen that the data obtained in the pre-test showed a maximum score of 56 students with an average score of 38,4. While the post-test shows the maximum score of students is 89 with an average of 63,8.

The data obtained were then analyzed by calculating the value of n-gain. Based on the calculation results, obtained N-gain of 0.42 with a medium category which indicates that the teaching materials developed can improve creative thinking skills. The developed flipbook is quite effective in improving creative thinking skills. That is because flipbooks facilitate the learning process, the material is easy to understand, there are videos that can facilitate understanding the material, are interesting to learn, and make it easier for students to learn independently (Romayanti et al., 2020). The results of other studies also show that electronic books with flipbook media and STEM-based teaching materials are able to improve students' creative thinking skills (Mulyadi et al., 2016; Salamiyah & Kholiq, 2020; Wahyuni & Rahayu, 2021). Then the student response questionnaire was distributed to find out the student's responses to the developed teaching materials. Student response questionnaires were distributed to find out whether the product could facilitate students in the learning process, facilitate students in designing projects, increase interest in learning, and train students to think creatively. Based on the results of student responses, 89% of students agree that this STEM-based flipbook teaching material can train students to think creatively.

In this study, a questionnaire was also filled out by biology subject teachers to determine the teacher's response to the teaching materials that had been developed. Based on the results of the teacher's response, obtained a percentage of 88%, which indicates that the developed teaching materials are suitable for use in the learning process. The teacher also agrees that teaching materials can assist in the delivery of respiratory system material and can train students' creative thinking skills through the STEM aspects contained in the flipbook. The developed flipbook is effective in improving students' creative thinking skills because there are features related to science, technology, engineering, and mathematics. In the STEM feature contained in the flipbook, problems regarding the human respiratory system are presented; other than that, students are also invited to create a project so that students are trained to think creatively in solving problems and assembling the project. In accordance with the results of Heryanti's research (2020) that STEM-based learning can improve creative thinking skills because through STEM learning, students learn by understanding a concept and carry out learning activities by making a project that can make students active in learning so as to grow students to think creatively.

STEM-based learning can affect students' creativity because STEM learning encourages students to combine knowledge, skills, and problem-solving abilities in everyday life (Dewi et al., 2017). In line with the research of Kristiani et al (2017) that STEM-based learning can make it easier for students to understand that one field of science is related to another. STEM helps students for students to solve problems by collaborating with each other. With STEM-based learning, students are asked to assemble a project so that in learning, students can play an active role, and this can grow students to think creatively, critically, and analytically.

Conclusion

Based on the results of this study, it can be concluded that STEM-based flipbooks on respiratory system materials can improve students' creative thinking skills. Students' creative thinking skills have increased, as evidenced by the results of the N-Gain analysis showing moderate criteria, which means that STEM-based flipbooks are suitable for use in learning and can improve creative thinking skills. These results are supported by the responses of teachers and students who gave a positive response to the teaching materials. Students and teachers agree that this STEM-based flipbook teaching material is feasible to use and can improve students' creative thinking skills.

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