

# The Effect of Using e-Books with the STEM-PjBL Approach on Students' Learning Motivation and Creative Thinking Ability

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**Abstract:** This research aims to determine the effect of e-book teaching materials on Temperature and Heat Science materials packaged with the STEM-PjBL approach in increasing students' learning motivation and creative thinking abilities. This research uses a quasi-experimental quantitative research method with a one group pretest-posttest design. The subjects in this research were 32 students in class VII C of SMP Negeri 5 Depok. The results of the research that has been carried out show the high learning motivation of students. For each indicator the conformity point is above 50%, so in this case it can be stated that students' opinions are more interested in using STEM-PjBL based science e-books. Meanwhile, students' creative thinking abilities show N-Gain values in each aspect, namely fluency of 0.45, flexibility of 0.38, novelty of 0.61, and usefulness of 0.62. The average N-Gain for creative thinking ability is 0.52 in the "Medium" category. In this way, STEM-PjBL based science e-books can create learning motivation and creative thinking abilities in students.

**Keywords:** Creative thinking; E-Book; Learning motivation; STEM PjBL

## Introduction

Science is a science that studies natural phenomena which becomes knowledge if it starts with a scientific attitude and uses scientific methods. Grahito Wicaksono (2020) states that in essence science includes scientific processes or methods, which are methods used to investigate problems, scientific products can be facts, principles, laws, theories and scientific attitudes referring to certain values that accompany the scientific process. Science learning should be able to relate situations directly to real conditions, because science focuses on studying everything that exists in nature (Gita et al., 2018). Science learning is a process that can help students learn more meaningfully through process skills, so that they can master scientific knowledge and natural laws and apply them in real life contexts. Science learning basically has to relate direct circumstances to actual reality or real conditions, because science studies everything that exists on earth.

Teaching materials are an alternative in delivering science material to students. However, conditions in the field, the development of teaching materials is still not suitable for science material and the methods used are still conventional. A similar thing was conveyed by Widiastuti (2020) that the majority of teachers are still lacking in developing teaching materials, by using teaching materials published by the government and methods that are still conventional, students tend to be passive and only receive information from the teacher so that learning is lacking. meaningful.

Innovative teaching materials need to be created to increase students' learning motivation (Ilafi et al., 2023). e-Books combine elements of text and attractive images, it is hoped that they can increase students' motivation to learn and deliver subject matter more easily to understand, thereby providing a different experience in the learning process (Musdalifa, 2021).

Teaching materials are something used by teachers or students to facilitate the learning process. The form can be in the form of reading books, workbooks (LKS),

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shows, and in the form of many things that are seen to increase students' knowledge or experience (Kosasih, 2021). One of the interesting teaching materials is e-books. An e-Book is a text that is presented or converted into digital form so that it becomes a computer file format and electronic image for display on a portable device (Kumar et al., 2009). e-Books have characters in the form of colorful image displays, animations, simulations, audio and video images that are able to support concepts and improve learning outcomes (Herrlinger et al., 2017).

STEM is an abbreviation of science (S), technology (T), engineering (E) and mathematics (M) which does not stand alone and is complex to develop students' creativity through problem solving (Widya et al., 2019). The STEM (Science, Technology, Engineering, Mathematics) approach in learning is able to connect theoretical mathematical concepts based on information technology with contextual problems in everyday life (I Wayan Widana, 2021). STEM can be implemented using various innovative learning models such as problem-based learning (PBL), inquiry, and Project Based Learning (PjBL). An innovative learning model that can be collaborated with STEM is the PjBL learning model. This is because the syntax in PjBL is aligned with STEM (Karlina et al., 2023).

The PjBL model provides opportunities for students to explore content using various ways that are meaningful to them and conduct experiments collaboratively (Astriani et al., 2023). Research from Zulyusri et al. (2023) shows that students who use the PjBL learning method have a higher level of creative thinking ability, because the PjBL syntax is able to provide stimulation for students to participate actively in the learning process. The PjBL learning model has the advantage of improving learning habits and motivating students to think originaly in solving problems in real life (Fitriyah et al., 2021).

This PjBL model provides opportunities for students to explore concepts in their own way, because students are given the opportunity to carry out experiments collaboratively, so that learning becomes meaningful (Astriani et al., 2023). The application of the STEM-based PjBL Model can encourage students to design, develop and utilize technology, hone cognitive, manipulative and affective skills, and apply knowledge (Wahyu et al., 2023). STEM-PjBL which is packaged in teaching materials in the form of e-books will be an innovation in delivering science material. With new things in the learning process, it is hoped that it can increase students' learning motivation. Research result Susanti et al. (2022) explained that the use of interactive digital books based on Project Based Learning (PjBL) can increase students' learning motivation. So it has

become a demand for teachers to be more creative in creating student learning motivation.

Motivation in the learning process will just appear because of self-encouragement (Lubis & Ikhsan, 2021). Motivation to learn is all the psychological driving force that exists within individual students and can provide encouragement to learn in order to achieve the goals of learning (Nuryasana & Desiningrum, 2020). Motivation is one of the supporting factors for improving thinking skills, because with motivation students are able to understand themselves and act as a driving force for learning activities to occur (Setianti et al., 2021). Learning motivation is a psychological factor that is not only related to intellectual aspects, but also plays a role in generating enthusiasm, happiness and passion for learning (Zakarya et al., 2022). Motivation to learn is an encouragement from oneself or factors that influence learning, without feeling forced.

Acesta (2020) explains that students' creative thinking abilities cannot be separated from the teacher's encouragement and motivation, students' creative thinking abilities grow or develop if teachers can stimulate students' creative thinking in the learning process. Students need creative thinking skills to develop themselves, find new ideas and develop them. Students' creative thinking can be created by being trained, accustomed to exploration from childhood, discovery and problem solving (Handayani & Koeswanti, 2021). Fitriyah et al. (2021) explained that to improve creative thinking skills, it is necessary to design a learning process that can lead students to achieve these goals. Molina et al. (2021) stated that creative thinking is the ability to come up with new and original ideas, even students who are unable to come up with new ideas can actually think creatively as long as they are trained. For this reason, teachers need to be more innovative in interesting learning, including choosing learning methods. This research was conducted to determine the effect of teaching materials, in the form of e-books, on science material packaged with the STEM-PjBL approach in increasing students' learning motivation and creative thinking abilities.

## Method

This research uses a quasi-experimental quantitative research method with a one group pretest-posttest design. The subjects in this research were 32 students in class VII C of SMP Negeri 5 Depok. Learning is carried out using the Temperature and Heat e-book which is integrated with the STEM-PjBL approach. This research was conducted to determine students' learning motivation and creative thinking abilities.

The data obtained was quantitative data produced from a pretest posttest questionnaire to measure creative thinking abilities. The data obtained was then analyzed using the equation from Hake and Richard (1999).

$$\text{Gain (g)} = \frac{\text{skor posttest} - \text{skor pretest}}{\text{skor maksimum} - \text{skor pretest}} \quad (1)$$

Meanwhile, data on increasing learning motivation was obtained from a learning motivation questionnaire with the Guttman scale. The Guttman Scale is a scale used to get firmer answers with clear questions. The answer made for the highest score (Yes) is one and the lowest score (No) is zero. Data were analyzed by calculating the percentage (%) for each "Yes" and "No" answer using the formula:

$$\% \text{ Answer Yes} = \frac{\sum \text{students answer "Yes"}}{\sum \text{all students}} \times 100\% \quad (2)$$

$$\% \text{ Answer No} = \frac{\sum \text{students answer "No"}}{\sum \text{all students}} \times 100\% \quad (3)$$

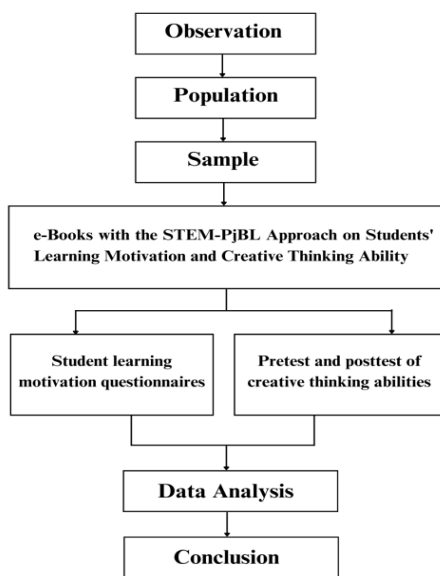


Figure 1. Research flow

## Result and Discussion

The teaching materials used in this research are e-books which were developed by integrating the STEM-PjBL model in Temperature and Heat material. The e-Book used has gone through validation and revision stages, so it is suitable for implementation in classroom learning. This e-Book was developed with the help of Canva software, the presentation is adapted to the syntax of STEM-PjBL. The STEM-PjBL syntax used is: start with the essential question, design a plan for the project, create a schedule, monitor the students and the

progress of the project, asses the outcome, dan evaluate the experience.



Figure 2. e-Book display

Students' learning motivation is measured using a learning motivation questionnaire, containing 30 statements developed from 5 learning motivation indicators. The indicators of learning motivation are: The desire and desire to succeed, the encouragement and need for learning, the hope and aspirations for the future, the existence of interesting activities in learning, and the existence of a conducive learning environment.

Table 1. Learning Motivation Questionnaire Grid

Indicator	Aspect	Item Number
There is passion and desire to succeed	Active in learning	1-15
	Enjoy learning	
	Don't give up quickly	
	Not quickly satisfied with the results obtained	
There is encouragement and need for learning	Tenacious in facing learning difficulties	16-21
	Have clear goals in learning	
	Curiosity	
There are hopes and aspirations for the future	There is feedback	22,23
	Interest in learning	
	Look for things related to learning	
There are interesting activities in learning	Perseverance in learning	24-27
	Avoid punishment	
There is a conducive learning environment	Praise (Award)	28-30
	Get achievements in class	
	The atmosphere of a place to study	
	Happy with the way the teacher teaches in class	

In Table 1, a learning motivation questionnaire grid is presented which will be used as a guide in developing questions in the form of statements. The learning motivation questionnaire that has been developed is then distributed to students after learning using STEM-PjBL based e-books. The results of the learning motivation questionnaire were analyzed to obtain the percentage value for each indicator. The results of the analysis of students' learning motivation questionnaires using STEM-PjBL based e-books are shown in Table 2.

**Table 2.** Results of student Learning Motivation Questionnaires

Indicator	Yes	No
There is passion and desire to succeed	78%	22%
There is encouragement and need for learning	63%	38%
There are hopes and aspirations for the future	78%	22%
There are interesting activities in learning	81%	19%
There is a conducive learning environment	69%	31%

Results of students' learning motivation when learning using the Temperature and Heat e-book with the STEM-PjBL approach, which was carried out at SMP Negeri 5 Depok. For each indicator, the conformity point is above 50%, so in this case it can be stated that the students' opinions are closer to yes or are interested in using STEM-PjBL based science e-books. Thus, STEM-PjBL based e-books are able to increase students' learning motivation.

Students' creative thinking abilities are measured using a test in the form of 10 essay questions. The questions were developed from several aspects, namely: Fluency, Flexibility, Novelty, and Usefulness. Data on the results of students' creative thinking abilities were obtained through pretest and posttest. The results of the pretest and posttest of generic science skills are shown in Table 3.

**Table 3.** Pretest and Posttest Results of Creative Thinking Abilities

Aspect	Pretest	Posttest	Gain
Fluency	80	86	0.45
Flexibility	78	97	0.38
Novelty	41	94	0.61
Usefulness	95	196	0.62

The results of the analysis of students' creative thinking abilities show N-gain in each aspect, in the Fluency aspect it is 0.45, flexibility is 0.38, Novelty is 0.61, and Usefulness is 0.62. The average N-Gain for creative thinking ability is 0.52. The criteria for increasing creative thinking abilities are presented in Table 4.

**Table 4.** Criteria for Increasing Creative Thinking Abilities

Limitation	Category
$g \geq 0.70$	High
$0.30 \leq g < 0.70$	Medium
$g < 0.30$	Low

Referring to the criteria for increasing creative thinking abilities in Table 4, the average N-Gain result of 0.52 is in the "Medium" category. Thus, the STEM-PjBL based e-book on Temperature and Heat is able to improve students' creative thinking abilities.

Altatri Adelisha (2024) stated that the application of the project-based learning model (PjBL) had a positive impact on increasing students' creative thinking abilities in biology learning. The combination of the Project Based Learning (PjBL) model with the STEM approach can increase students' interest in learning, make learning meaningful, and help students solve problems and provide challenges and motivation for students, because it is able to train students to think creatively mathematically (Maria et al., 2019).

## Conclusion

The STEM-PjBL based science e-book on Temperature and Heat is able to increase students' learning motivation. For each indicator, the conformity point is above 50%, so in this case it can be stated that students' opinions are more interested in using STEM-PjBL based science e-books. Meanwhile, for students' creative thinking abilities, the average N-Gain result was 0.52 in the "Medium" category. Thus, e-books based on STEM-PjBL on Temperature and Heat can increase students' learning motivation and creative thinking abilities.

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## Author Contributions

M. M. I: designing research concepts, analyzing research data, writing articles, editing e-book products, the process of creating STEM-PjBL based e-book products, designing methodologies, as well as coordinating and implementing research activities. Meanwhile, the instruments used in the entire development research process have gone through the validation and evaluation stages, as well as editing carried out by S; I. W; S. N : with this team collaboration, the research was successfully carried out effectively and structured to achieve the objectives.

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### Conflicts of Interest

The authors declare no conflict of interest.

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