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## Global Warming E-Books based on Learning style: Is it Effective to Enhance Students' Problem-Solving Skills?

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### ABSTRACT

*This study was conducted to assess the effectiveness of using physics e-books adapted to learning style in understanding material about global warming and improving students' problem-solving skills. The independent variable in this study was the use of physics e-books based on learning style in global warming material, while the dependent variable was students' skills to solve related problems. The research method used was pre-experimental with a one-group pretest-posttest design at SMAN 10 Yogyakarta, involving 61 grade X students who were selected using a purposive sampling technique. Assessment of students' problem-solving skills is carried out by referring to previously established indicators. The data were then analyzed using SPSS, including tests for normality, homogeneity, one-way ANOVA, and N-gain. The research results indicated that although students' problem-solving abilities were in the moderate category, the use of physics e-books integrating students' learning styles significantly improved their understanding of global warming material. This indicates that the use of electronic teaching materials that are adapted to students' learning styles can have a positive impact on their cognitive development. Thus, students can learn more effectively by adhering to their respective learning styles and overcoming learning challenges through the guidance provided in the e-book.*

## INTRODUCTION

In the 21st century, advancements have been rapid, particularly in the field of education. Alongside these advancements, students are indirectly expected to possess skills relevant to the demands of the times. Teachers, as central figures in the learning process, play a crucial role in assisting students in acquiring these skills. Quality teachers are believed to have a significant impact on student achievement [1]. One of the highly anticipated skills from learners is the ability to solve problems.

The steps in solving a problem, including understanding the problem, planning a solution, implementing the plan, and evaluating the solution [2]. In the educational context, problem-solving skills are considered highly important because they serve as a foundation for developing other skills such as critical, analytical, and creative thinking. This statement aligns with the research [3], which states that problem-solving skills is a high-level cognitive skill that enables students to acquire knowledge and skills.

Problem-solving is a complex skill as it requires individuals to employ high-level thinking skills in addressing challenges [4]. Therefore, this skill is highly vital due to its broad relevance in everyday life [5]. Physics, as a discipline rooted in natural principles, has a close relationship with the surrounding reality, making problem-solving skills in the context of physics learning equally important for learners.

In the context of the classroom learning process, instructional models play a crucial role. Instructional models serve as frameworks or plans used to develop long-term curricula, design instructional materials, and provide guidance in the classroom or other learning environments [6]. Instructional models have a structure that provides clarity in the learning process, making it systematic and organized. Choosing the appropriate instructional model can help achieve the skills desired by students. Instructional models can be selected based on the learning needs to achieve desired objectives.

Instructional models provide guidance for teachers in organizing the learning process in the classroom. Alongside this, teachers are faced with the demand to provide effective teaching that benefits both themselves and the students [7]. Instructional models also play a significant role in shaping various skills that learners will acquire. In efforts to enhance problem-solving skills, there are various instructional models that can be utilized, and numerous studies have explored this. For example, instructional models like Problem-Based Learning (PBL) have been proven to help improve students' problem-solving abilities. The use of PBL has been found to bring about significant improvements in various aspects such as learning attitudes, decision-making, problem-solving skills, critical thinking, and motivation [8].

Based on observation results in the classroom learning process, instructional models are often accompanied by specific approaches or learning strategies. One recommended learning strategy is the differentiation approach. Differentiation approach is a teaching strategy that adjusts the learning method according to students' interests, learning preferences, and readiness, with the aim of improving learning outcomes [9]. The use of differentiation approach is based on an understanding of individual learning styles, which can be identified using validated software.

Students' learning styles can be grouped into three main types: visual, auditory, and kinesthetic [10]. The role of these learning styles is significant in the learning process because students are often forced to learn using methods that do not match their learning styles, which can hinder their concentration when information is delivered by the teacher. Therefore, students' learning styles have a significant impact on their learning outcomes.

In addition to instructional models, teaching materials, and learning media also play a crucial role in the learning process. With the advancement of technology, the use of technology has significantly impacted the evolution of teaching materials. One striking example is the shift from print books to electronic books, more commonly known as e-books, as a learning resource for learners. The use of e-books is increasingly popular due to their convenience, affordability, and ability to present meaningful animations. E-books provide opportunities to transform difficult learning into a more dynamic process by actively applying knowledge and skills through multimedia and interactive approaches [11][12]. Furthermore, e-books can be designed as learning media used to enhance specific abilities or skills, such as problem-solving skills for learners.

Based on the above description, it is evident that conducting research on the implementation of physics e-books tailored to learners' learning styles is crucial. The aim of this research is to evaluate whether the use of physics e-books designed based on individual learning styles can help improve learners' problem-solving abilities. Thus, this research will provide valuable insights into the effectiveness of using e-books in the context of physics education, as well as understanding its influence on students' problem-solving abilities.

### METHOD

This study using a quasi-experimental design, because each student receives the same treatment, utilizing a one group pretest-posttest research design. It involves one class for modeling and another for implementation. Table 1 illustrates the study design as follows.

**Table 1.** Research Design

Class	Pretest	Treatment	Posttest
Modeling	O <sub>1</sub>	X	O <sub>2</sub>
Implementation	O <sub>1</sub>	X	O <sub>2</sub>

**Information**

- O<sub>1</sub> : Pretest of students; problem solving skills
- X : The use of Physics E-Book based on learning style in global warming material
- O<sub>2</sub> : Posttest of student’s problem-solving skills

The study was conducted out throughout the 2023/2024 academic year at SMAN 10 Yogyakarta. Both the modeling and implementation classes utilized e-book based on learning style as instructional material in learning about global warming. The modeling class was taught by the researcher, while the implementation class was taught by a physics teacher at the school. The sampling technique in this study used purposive sampling, with the rules that students take part in pretest, learning, and posttest activities. This study involved 71 X-grade students, with details of 35 students from class X-4 (implementation class) and 36 students from class X-5 (modeling class). The study variables consisted of independent and dependent variables. E-book based one learning style as the independent variable and students’ problem-solving skills as the dependent variable.

Data collection was conducted using a test technique. Problem-solving skills indicator included identifying problems, defining and presenting problems, looking for alternative solutions, choosing the best solution, and evaluating the chosen solution. These five indicators formed the basis for creating the test instrument. The test consists of four essay questions consisting of 11 questions.

Research data was analyzed based on pretest and posttest results, these results were tested using the N-Gain equation as show in equation 1. Data analysis aimed to compare students’ problem-solving skills before and after using the physics e-book based on learning styles in the context of global warming. According to Table 2, there were three different categories identified from the analysis.

$$g = \frac{S_{posttest} - S_{pretest}}{S_{ideal} - S_{pretest}} \tag{1}$$

**Information:**

- g : N-Gain score
- S<sub>pretest</sub> : Pretest mean score
- S<sub>posttest</sub> : Posttest mean score
- S<sub>ideal</sub> : Maximal score

**Table 2.** Interpretation of N-Gain Score

Normalized N-Gain Score	Interpretation
$g > 0,7$	High
$0,3 < g \leq 0,7$	Medium
$g \leq 0,3$	Low

## RESULTS AND DISCUSSIONS

Test instruments to measure problem-solving skills in the context of global warming have been tested by experts, and the results indicate that the instruments are valid for use. This research involved two classes, namely the modeling class and the implementation class. Therefore, the results of this study are divided into two parts, with the modeling class led by a researcher and the implementation class led by a physics teacher. The modeling class was held in class X-5, while the implementation class was held in class X-4.

### *Normality Test*

Data from pretest and posttest results of problem-solving abilities in the modeling and implementation classes were analyzed using the Shapiro-Wilk normality test. The results of the normality test are presented in Table 3. The significance values for pretest and posttest problem-solving abilities in both the modeling and implementation classes are greater than 0.05. This indicates that the pretest and posttest data for problem-solving abilities in both classes have a normal distribution.

**Table 3.** Normality Test Results

Class	Test	Saphiro-Wilk		
		Statistic	df	Sig.
Modeling	Pretest	.618	31	0.618
	Posttest	.230	31	0.230
Implementation	Pretest	.935	30	0.067
	Posttest	.937	30	0.075

### *Homogeneity Test*

Table 4 displays the results of the homogeneity test with significance values of 0.188 and 0.667 for the modeling class and the implementation class, respectively. Both significance values are greater than 0.05. Thus, it can be concluded that both the modeling class and the implementation class have homogeneous problem-solving ability variables.

**Table 4.** Homogeneity Test Results

Class	Levene Statistic	df1	df2	Sig.
Modeling	1.773	1	60	.188
Implementation	.187	1	58	.667

### *Improved Problem-Solving skills*

The pretest and posttest scores were subjects to an N-gain test to measure the improvement in students' problem-solving skills. Data reflecting students' problem-solving skills in the modeling class are presented in Table 5, while the N-gain results are presented in Table 6.

**Table 5.** The Modeling Class Test Results

Result	Pretest	Posttest
The Highest Score	63.64	86.36
The lowest score	27.27	56.82
The Average score	47.62	72.79
Increase of average score	25,17	

**Table 6.** The N-gain Score Analysis of The Modeling Class

The Highest Value	The Lowest Value	The Average Value
0.71	0.3	0.48

With an average N-gain score of 0.48 in students’ problem-solving skills, as indicated in the previous table, it shows that the improvement in students’ problem-solving skills falls within the moderate category. The use of E-books in learning can be an alternative to enhance problem solving skills [13].

The results of students’ problem-solving skills in the implementation class are presented in Table 7, while the N-gain analysis is found in Table 8.

**Table 7.** The Implementation class test results

Result	Pretest	Posttest
The Highest Score	63.6	83
The lowest score	34.1	60
The Average score	44.95	74.57
Increase of average score		29.62

**Table 8.** The N-gain Score Analysis of The Implementation Class

The Highest Value	The Lowest Value	The Average Value
0.74	0.35	0.535

The average N-gain value of students shown in the table above is 0.535. This value indicates that the improvement in students’ problem-solving skills falls within the moderate category. The use of E-book based on learning style is quite helpful for students to improve problem solving skills.

In the modeling and implementation class, there are several students who have not reached the average standard on the problem-solving skills test. There are several factors that may cause this. One of them is the lack of dedication from students in following the lesson, leading to their daily experiences. Additionally, there is a possibility that students do not access the E-book according to their learning style. This deficiency has the potential to hinder students’ ability to solve problems.

From the other side, the use of E-books that are adapted to learning styles and integrated with problem-based learning (PBL) models can significantly improve students’ problem-solving skills. Implementing problem-based learning as a teaching approach can effectively improve students’ skills in problem solving. This study aims to improve students’ problem -solving skills through the use of physics E-boos that are adapted to individual learning styles. With improved problem-solving skills, students can better comprehend the material taught by teachers and tackle challenges related to global warming issues, both in academic and non-academic contexts.

In the learning activities, both in the modeling and implementation classes, the classes are divided into several study groups based on the results of the previous learning style tests. E-books are distributed through the student chat groups in both classes. Students participate in the learning process with the assistance of student worksheets (LKPD) and use physics E-books that are adapted to their learning style as the main source of material. Figure 1 shows an example of an E-book that is the focus of this research.



Fig 1. E-book Based Learning Style

The teacher presents the problem through the student worksheets, which are also displayed via PowerPoint presentation. Students are directed to understand the problem and seek solutions using the E-book as the main source. Each group of students uses an E-book that aligns with their learning style, with a focus on visual and auditory learning style. This approach allows students to absorb information more effectively according to their learning preferences, which in turn helps them understand the learning material presented by the teacher.

Students use E-book as a means to find solutions to the problems presented in the student worksheets. They can scan the QR code provided, which corresponds to their individual learning style. Figure 2 illustrates the display of the E-book containing material on global warming, which is adapted to students' learning style.



Fig 2. QR Code in the Book

Both the modeling and implementation classes implement the problem-based learning (PBL) teaching model. The research results indicate that both classes experienced an increase in the ratio between pretest and posttest scores. The use of the problem-based learning (PBL) model can significantly enhance learners' problem-solving skills [14]. This E-book has the advantage of being an interactive learning material that cannot be provided by regular printed books. The PBL model is implemented in five steps, with the aim of enabling students to find solutions to the problems encountered in their learning process.

#### *The Effective Treatment Contributions*

After ensuring that the research data meets the assumptions of normality and homogeneity, the next

step is to conduct a one-way ANOVA test, also known as an F-test. This test aims to compare the mean pretest and posttest scores between the modeling class and the implementation class. The results of the one-way ANOVA test are presented in Table 9, which also shows the magnitude of the effect for each class.

**Table 9.** The Effective Treatments Contribution

<b>Class</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>Sig.</b>	<b>Eta-Square</b>
Modeling	1	9823.726	121.930	.000	.670
Implementation	1	13161.647	299.080	.000	.838

The study results indicate a significant difference between the test in the modeling and implementation classes, as listed in Table 9. The significance values shown in Table 9 are lower than 0.05, indicating a statistically significant difference.

From Table 9, we can also ascertain the partial eta squared values, which are the result of the ANOVA effect size. The partial eta squared values can be used to evaluate the effect of treatment in the modeling and implementation classes. In modeling class, the use of E-book base learning style significantly increased students’ problem-solving skills by 67%. Meanwhile, in the Implementation class, the improvement in students’ problem-solving skills reached 83.3%. from these results, it can be concluded that the use of E-book based on learning styles on global warming material using the PBL learning model in implementation classes provides a higher increase in students’ problem-solving skills compared to modeling classes.

The use of learning styles in learning can provide learning experiences that are in accordance with the learning methods, learning needs, and learning activities of students. Therefore, learning material are arranged based on the learning styles of students’ with the form based on the learning styles of students with the form of activities that are in accordance with learning styles.

The discussion above illustrates how physics E-book that are adapted to students’ learning style in global warming material contribute to improving their problem-solving skills. These findings are in line with previous research showing that E-books can be a choice to enhance learners’ problem-solving skills [15]. Apart from that, using e-books is more practical and interesting for students’ use, so that learning is more meaningful.

## CONCLUSION AND SUGGESTION

The main aim of this research is to show how the use of physics E-books adapted to learning styles about global warming can improve problem-solving skills. The use of E-books arranged based on learning styles turns out to significantly improve students’ problem-solving skills, as reflected in the high influence scores in modeling and implementation classes, namely 67% and 83.8%. Recommendations that can be drawn from the results of this research include various things, one of which is developing the appearance design of E-books to make them more attractive so as to encourage students’ interest in using them. Apart from that, it is also recommended to include example questions and practice questions in the E-book, so that teachers can monitor student progress more effectively. Thus, the use of E-book enriched with these features can be a more effective learning tool and strengthen students’ problem-solving skills.

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