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The Use of Problem-Solving Based Physics Comic Media on Global Warming Material in Increasing Learning Motivation and Students' Understanding Concept

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Abstract: Learning media is an intermediary in the learning process, and is expected to arouse student motivation in learning activities, especially in physics lessons. However, some teachers have difficulty adapting the media to the material that will be provided, especially global warming material. So that causes a lack of interest in learning students to read textbooks, which results in a low understanding of students' concepts of physics subjects, especially on global warming material. The purpose of this study was to determine the increase in learning motivation and understanding of students' concepts through the use of problem solving-based physics comics on global warming material. The method used in this study is qualitative, a type of quasi-experimental research (quasi-experiment). The research design used was a two-group pretest-posttest design. Totaling 30 students selected by cluster random sampling. The instruments used in this study were test instruments (pretest-posttest) and non-test instruments (questionnaires). Data analysis shows the value of Sig. < 0.05, namely 0.00, thus Ho is rejected and Ha is accepted. It can be concluded that the use of problem solving-based physics comic media on global warming material can improve students' understanding of concepts.

Keywords: learning motivation; pysics comic; problem solving; students' understanding concept.

Introduction

The problem of education is very complex, various efforts have been made to create a quality learning process, one of which is by utilizing educational facilities and infrastructure that can support the teaching and learning process, especially in physics subjects. According to Chodijah et al(Yakin et al., 2018)physics is one of the subjects that is associated with national intelligence and has a major role in supporting science and technology, thus requiring teachers to be able to design and implement education that is more focused on mastering physics concepts. Where one of the objectives of learning physics is to build students' conceptual understanding to explain various physical phenomena and solve existing problems(Taqwa & Rivaldo, 2019). Thus, students need motivation to be able to learn the concepts of physics itself. According to(Kartika et al., 2023) one of the aspects that influence the success of learning in class is the learning media used. Learning media apart from arousing student motivation and interest in learning activities, can also help students improve their understanding of concepts, present interesting data, facilitate interpretation of data, and condense information (Riska, 2022).

The problems that occur based on the results of observations and interviews that have been conducted are that there are still students who do not like and are lazy to read textbooks, students think that physics is only formulas and mathematical figures that must be completed with very complicated calculations and readings so that students are not interested in read textbooks. Most students only open books when given assignments, so when in class students do not understand what they are learning. Another problem is that teachers are less innovative in using learning media,

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due to the teacher's difficulties in adapting the media to the material, so students only take notes when listening to material descriptions, especially on global warming material. These problems may be due to the use of inaccurate methods, resulting in a lack of student motivation in learning and students having difficulty understanding the concepts of the material being taught.

Therefore, the solution to the problem needed is teacher creativity in presenting innovative and interactive learning media so that students are motivated and easy to understand learning. One of the innovative media that can be used is comic media. According to Cintya, et al (Aprilla, 2020), comic learning media is media that is simple, easy to understand, and fun so that it is informative and educative. As a visual communication medium, comics can be used as a learning medium that can convey information effectively and efficiently (Nugroho & Shodikin, 2018). Comics are one of the authentic media to clearly describe the reality of everyday life, because the visuals, style of language, and codes in comics can also attract students' interest to facilitate mastery of concepts. So the presence of comic media will make the learning process more interesting(Aprilla, 2020).

Previous research has been carried out by Kaleka et al., (2022) with the title of research on the use of comic media in straight motion material to determine students' interest in learning physics. This study aims to determine students' interest in learning after applying comic media to straight motion material. The results of this study indicate that the average interest in learning physics after being taught using comic media is in the very good category. Further research with the title development of comic-shaped physics handouts using PBL, which was studied by Zarvianti & Sahida, (2020). This study aims to produce teaching materials that are valid, practical, and effective. The final results of this study are the results of the development of physics handouts in the form of comics using PBL that meet valid, practical, and effective criteria. This shows that physics handouts in the form of comics are effectively used in learning. The research conducted by Haroky et al.(2019)with the title research learning physics using android comics to improve students' Understanding of Concepts. This study aims to determine students' understanding of concepts using physics comic media. The results of this study indicate that Android-based comic media can train students' understanding of concepts in learning

Based on some previous research, researchers tried to be innovative through the use of problem solving-based physics comics, because comics can attract students' interest in learning and reading, they can be designed according to the material to be delivered so students can solve the problems given. Problem solving learning itself has advantages that correspond to the characteristics of physics so it is relevant to learning physics. According to Fitriyanto et al(Taqwa & Rivaldo, 2019)problem solving plays a role in building students' knowledge, so it is very suitable to be combined with physics comic media. In this modern era, students' reading interest in textbooks is very low, and also the complexity of the teaching materials delivered makes students less and less interested in reading textbooks. On the other hand, students tend to be more interested in cellphones and story books such as novels and comics. This is because these storybooks have pictures, and a coherent and orderly storyline making it easier for students to remember the content presented (Riska, 2022).

Utilization of problem solving-based physics comic media can help students understand the material more easily and with fun, with the hope that students can also easily solve physics problems. According to Tatalovic (Badeo & Koc, 2018)comics are a potential and effective medium for learning science. In addition, according to Affeldt et al. (Badeo & Koc, 2018) the use of comics in science learning is much better than traditional textbook-based learning because the contents contain learning materials set in meaningful contexts made with certain images. Effective learning media is learning media that can make students happy in learning so that students more easily understand the material(Kartika et al., 2023). Efforts to increase students' interest in learning can be done by presenting photos and interesting story texts in student reading books. Most students are more interested in reading picture storybooks. Comic media is a book that is dominated by cartoon images where the same character forms a story in a sequence of images that are closely related and designed to entertain the readers (Latul, 2022). Based on this description, the purpose of this study was to determine the increase in learning motivation and understanding of students' concepts through the use of problem solving-based physics comic media on global warming material.

Method

This research is included in the type of quasi-experimental research (quasi-experimental research), which is research that is close to a real experiment and also aims to find out the effect of something imposed on the subject (students). The research design used in this study was a two-group pretest-posttest design (Sugiyono, 2018). Before being given treatment, students in the control and experimental classes were given pretest questions in the form of description questions consisting of 5 questions, to measure students' initial

conceptual understanding abilities and also given a learning motivation questionnaire. After being given learning using problem solving-based physics comics media in the experimental class and conventional learning in the control class, students were given posttest questions about understanding concepts and learning motivation questionnaires.

This research was conducted at SMA Negeri 2 Peusangan. The population in this study were all students of class X consisting of 7 classes totaling 210 students. Totaling 30 students selected by cluster random sampling. The sampling method was carried out randomly (Cluster random sampling). A total of two classes, namely one class as an experimental class is a class that uses comic media based on problem solving in learning and the control class is a class that uses textbooks (package books) in learning.

The instruments used in this study consisted of 2 instruments, namely test instruments and non-test instruments. The test instrument is used to measure the level of students' understanding of concepts before and after being given treatment. The instrument for understanding the concept test is in the form of 5-item description questions, given as pretest and posttest questions. While the non-test instrument is in the form of a learning motivation questionnaire which contains questions that indicate the level of student motivation toward physics lessons. In this study, the learning motivation questionnaire was distributed twice. The first questionnaire was distributed before the learning process takes place, to determine the level of student motivation before being given treatment. Then the second questionnaire was distributed after the learning process took place, the aim was to determine the level of motivation to learn after being given treatment. The learning motivation questionnaire contains as many as 20 statement items.

Data Collection and Analysis Techniques

1. Test

Data collection techniques for test instruments in the form of data on students' conceptual understanding using pretest, posttest, and N-Gain Score (g). The pretest is given before the learning process to see students' initial conceptual understanding before being given treatment. Posttest is given after the learning process to see students' understanding of concepts after being given treatment. While the N-Gain Score is used to determine the increase in pretest and post-test scores.

2. Questionnaire

Non-test instrument data collection is in the form of a learning motivation questionnaire. Data collection was carried out by filling out a motivational questionnaire by students. The questionnaire was given before being given treatment and after being given treatment. Questionnaire data on learning motivation is in the form of a checklist (√) with a Likert scale. The questionnaire scoring system is as Table 1.

Table 1. Questionnaire Data Scores.

Question Type	Conformity Level			
	Always	Sometimes	Rarely	Neve
Negative Questions	1	2	3	4
Positive Questions	4	3	2	1

Hypothesis testing was analyzed using the Mean Difference Test using the Mann-Whitney test through SPSS software version 23. The hypothesis proposed is:

Ho: there is no significant difference in value between the two groups

Ha: there is a significant difference in scores between the two groups

The criterion for testing the hypothesis is Reject Ho if Sig < 0.05

Result and Discussion

This research was conducted on global warming material in class X SMA Negeri2 Peusangan to know the increase in learning motivation and understanding of students' concepts through the use of problem solving-based physics comic media. The research was carried out by carrying out the teaching and learning process using problem solving based comic media in the experimental class and carrying out the teaching and learning process using textbooks in the control class. The research was conducted in 2 meetings.

In this study, an increase in understanding of the concept was seen from the acquisition of the pretest and posttest scores that had been given. As for the motivation from the results of the questionnaire that was distributed. In detail it is explained as follows:

Analysis of Students' Understanding of Concepts

The results of processing students' conceptual understanding of data show that students' conceptual understanding in the experimental class is better than the control class. This is proven by the number of questions that students can solve after the teaching and learning process takes place so that the average post-test results are higher than the average student pre-test results. An overview of improving students' understanding of concepts in the control class and experimental class can be seen in Table 2.

Table 2. General Description of Students' Understanding of Control and Experiment Class Concepts

Nilai	Control		Experiment	
	Pre-test	Post-test	Pre-test	Post-test
Highest	13	16	15	23
Lowest	1	9	0	16
Average	4.0	12.7	6	18.8
Variance	2.58	2.05	3.80	2.23
Standard deviation	6.65	4.22	14.45	4.99

Table 1 shows that the average score in the posttest of the experimental class was higher than that of the control class, thus it can be said that the student's understanding of the concepts in the experimental class that used problem solving-based physics comics was better than the control class that used textbooks. (Aprilla, 2020)states that comics are simple learning media, easy to understand, and can attract interest so that they are informative and educative. An overview of improving students' understanding of concepts can be seen in Figure 1.

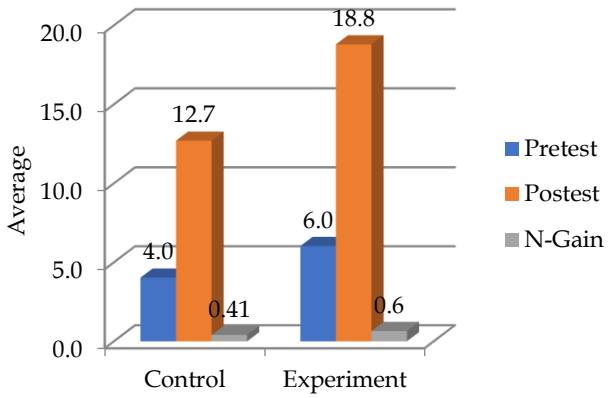

Figure 1. Improvement of Concept Understanding Scores in the Control and Experiment Classes

Figure 1 shows that there is an increase in the average score in both the control class and the experimental class, but the increase in the average score in the experimental class is higher than the control class. Although both are in the medium category, the N-Gain value in the experimental class is higher than the control class. Students' concept understanding questions were prepared based on indicators of conceptual understanding. Questions were given before and after treatment to see an increase in students' understanding of concepts. As for the questions given in the pre-test and post-test, they are the same questions, only the order of the questions is random. The details of the questions in the control class and experimental class can be seen in Table 3.

Table 3. Question Details Based on Concept Understanding Indicators

Sub Concept	Question item number	
	Pre-test	Post-test
Give an example	1	4
Explain	2	5
Summarize	3	1
Conclude	4	2
Classify	5	3

Increasing students' understanding of concepts is analyzed using the gain index formula. Students' understanding of concepts was analyzed per indicator of understanding of concepts. The results can be seen in Table 4.

Table 4. Improved Students' Understanding of Concepts in Each Indicator

Concept Understanding Indicator	Control		Experiment	
	N-Gain	Criteria	N-Gain	Criteria
Give an example	0.17	Low	0.54	Medium
Explain	0.67	Medium	0.61	Medium
Summarize	0.10	Low	0.61	Medium
Conclude	0.27	Low	0.69	Medium
classify	0.73	High	0.62	Medium
Average	0.39	Medium	0.61	Medium

The table 4shows that there are differences in the improvement of students' concepts in the experimental and control classes. The students' understanding of the concept of the experimental class was better than that of the control class students. This can be seen from the average N-Gain of the experimental class which is higher than that of the control class. In the experimental class, the average N-Gain for each indicator has increased to the moderate category. However, in the control class all indicators of understanding the concept are in the low category. Only the indicators classify as being in the high category and the indicators explain how many are in the medium category. The results of this study are in line with the research of Putra et al., (2018)who obtained an achievement score for each indicator of conceptual understanding in the experimental class higher than the control class. Thus, it can be stated that the use of problem solving-based physics comic media on global warming material in increasing students' conceptual understanding. To prove the hypothesis that the use of problem-solving-based physics comic media on global warming material can improve students' understanding of concepts, a hypothesis test was carried out using the SPSS 23 application at a significant level of 5% ($\alpha = 0.05$) the results are as follows:

Table 5. Hypothesis Testing Results Using the Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Understanding of Concepts	Equal variances assumed	2.461	.122	-6.401	58	.000	-.2433	.0380	-.3194	-.1672
	Equal variances not assumed			-6.401	51.887	.000	-.2433	.0380	-.3196	-.1670

Table 5 shows that the Sig. <0.05, namely 0.00, thus Ho is rejected and Ha is accepted, meaning that there is a significant difference in the scores of the control and experimental groups. It can be concluded that the use of problem solving-based physics comic media on global warming material is able to increase students' understanding of concepts. The results of this study are in line with Cholisoh's, (2021)research which states that comic media can increase student interest and learning outcomes in the concept of global warming symptoms. Comics are illustrated stories consisting of reading text and short dialogues which of course will make it easier for readers to understand a story (A. Putra & Milenia, 2021). In physics learning, comics are structured to provide clarity about a material in the form of illustrated stories, making it easier for students to understand learning material. Atikah et al., (2020)developed worksheets in the form of comics oriented towards problem solving. The result is that these worksheets in the form of comics are suitable for use in learning and are easy for students to understand and are able to improve the development of environmental care characters and students' cognitive learning outcomes. Physics comic media based on problem solving is able to improve students' understanding of concepts through real problems presented in the form of illustrated stories in comics.

Analysis of Student Learning Motivation

Student motivation in this study was measured using a questionnaire which was compiled based on indicators of learning motivation and then distributed before and after learning began. The indicators of motivation according to Mulyadi & Warnoto(2020)are: (1) There is a desire and desire to succeed, 2) There is encouragement and need for learning, 3) There are hopes and aspirations for the future, 4) There is appreciation in learning, 5) there is appreciation in learning, 5) there are interesting activities in learning, 6) there is a conducive learning environment, so that it allows a student to study well. The results of the motivational price analysis can be seen in Figure 2.

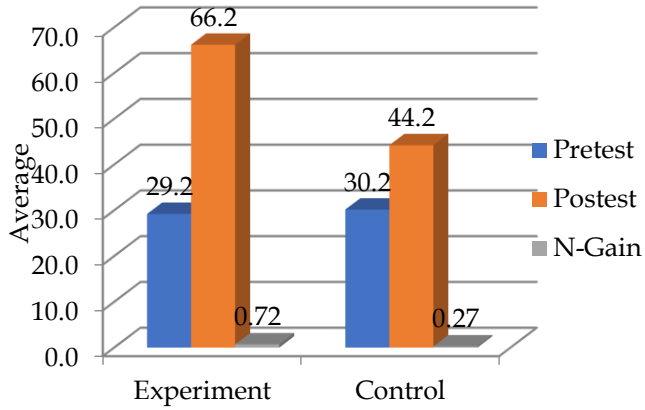

Figure 2. Increasing the Learning Motivation Score in the Control and Experiment Classes

Figure 2 shows that there is an increase in the average score in both the control class and the experimental class, but the increase in the average score in the experimental class is much higher than the control class. This can be seen clearly in the average N-Gain score, where in the control class the increase in N-Gain is in the low category, while in the experimental class it is in the high category. Thus it can be said that the learning motivation of the experimental class students is higher than the control class.

Learning motivation questionnaires were given before and after treatment to see an increase in student motivation. The questions given in the pre-test and post-test are the same questions. The increase in student learning motivation was analyzed using the gain index formula (N-gain) per learning motivation indicator. The results can be seen in Table 6.

Table 6. Increasing Student Learning Motivation in Each Indicator

Learning motivation indicator	Experiment		Control	
	N-Gain	Criteria	N-Gain	Criteria
There is passion and desire to succeed	0.69	Medium	0.42	Medium
There is a drive and need for learning	0.62	Medium	0.49	Medium
There are hopes and aspirations for the future	0.72	High	0.13	Low
There is an appreciation in learning	0.72	High	0.20	Low
There are interesting activities in learning	0.76	High	0.40	Medium
There is a conducive learning environment	0.78	High	0.22	Low
Average	0.72	Tinggi	0.31	Medium

Table 6 shows that the increase in student motivation in the control class is better than in the experimental class. This can be seen from the average N-gain value of the experimental class which is in the high category, while the control class is in the medium category. Thus it can be said that the Use of Problem Solving Based Physics Comic Media can increase student learning motivation. This statement is in line with Mahendra et al.(2021) who stated that the use of comics in learning affects student learning motivation. in line with this, Rosadi & Karimah(2021)stated that motivation is a very important aspect of tshe learning process in the classroom because it can expedite the learning process. However, in reality, not a few students lose their motivation to learn, so teachers must do various ways to increase student interest in learning. Gunawan & Sujarwo(2022)states that one of the media that can improve student learning outcomes is comics. The results of this study also prove that the use of comics in learning can increase student motivation.

Conclusion

Based on the results of data analysis that has been done, it can be concluded that the use of problem solving-based physics comic media on global warming material can increase students' learning motivation and understanding of concepts. Due to the limitations of the researchers, this research was only conducted for several cognitive aspects, namely conceptual understanding and learning motivation. It is hoped that there will be further research to find out other skills indicators that can be developed through the use of comics.

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Author Contributions

The first and second authors have a very big contribution in this research. Where the two writers share the task very well. The first author completes the research proposal and instruments while the second author tests the instrument and analyzes the research data. Research and articles are completed together.

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Conflicts of Interest

The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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