

The Effect of Using the Word Search Inquiry Model on Conceptual Understanding and Self-Efficacy in Global Warming Physics Content

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Received: June 13, 2024

Revised: July 29, 2024

Accepted: September 25, 2024

Published: September 30, 2024

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DOI: [10.29303/jppipa.v10i9.8086](https://doi.org/10.29303/jppipa.v10i9.8086)

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Abstract: To be able to create meaningful learning, educators need appropriate learning strategies. This will have a positive impact on students. Based on the results of observations of physics learning, global warming material at SMA N 1 Bantul requires the development of formative assessment media that can support classroom learning. This research aims to measure the feasibility and influence of using the word search inquiry model on conceptual understanding and self-efficacy in global warming material. The research method used is field research including the interview process, observation and documentation. Feasibility test data analysis was carried out using Likert scale analysis and influence data analysis using paired simple t-test data analysis techniques using SPSS. This research was conducted on class X students at SMA N 1 Bantul. The feasibility test data analysis obtained was 91.04% or very feasible. The test results showed a significant effect on the pre-test and post-test data. Based on the research that has been conducted, it can be concluded that using the word search inquiry model can increase students' conceptual understanding and self-efficacy.

Keywords: Global warming; Physics education; Self-efficacy; Understanding of concepts; Word search;

Introduction

Learning models in teaching and learning activities have an important role in the process of students' understanding of concepts (Sukri, A., Rizka, M. A., Purwanti, E., Ramdiah, S., & Lukitasari, 2022). In physics learning, a learning model is needed that involves students playing an active role in the learning process (Botezatu & Birnaz, 2023). Meaningful learning is important in a learning activity (Ananda Kumar, 2023). The inquiry learning model is a student-centered teaching strategy, which encourages students to investigate problems and find information (Mutlu, 2023). This inquiry learning strategy includes the steps orientation, formulating the problem, formulating a hypothesis, collecting data, testing the hypothesis, and

formulating conclusions (Prihantoro, 2020; Susanto & Zaya, 2023). The stages in this learning model can foster students' understanding of concepts.

Understanding concepts is the ability to grasp understandings such as being able to express material presented in a more understandable form, being able to provide interpretations and being able to apply them (Maknun, 2020). In physics learning, understanding concepts is a very basic thing that students must have (Capriconia & Mufit, 2022; Saputra & Mustika, 2022; Siong et al., 2023). This aims to minimize the occurrence of misconceptions among students. A good understanding of concepts related to global warming material will support the implementation of meaningful learning (Habashy & Cruz, 2021; Siregar et al., 2023). Global warming is a phenomenon of increasing the

How to Cite:

Laeli, S., & Wiyatmo, Y. (2024). The Effect of Using the Word Search Inquiry Model on Conceptual Understanding and Self-Efficacy in Global Warming Physics Content. *Jurnal Penelitian Pendidikan IPA*, 10(9), 6962–6969. <https://doi.org/10.29303/jppipa.v10i9.8086>

average temperature on the earth's surface. In the last 100 years, the earth's temperature has increased quite rapidly, with an average increase of 0.6 – 0.9 degrees (Rosidin & Suyatna, 2017). Global warming is one of the physics materials that studies current environmental issues and students can experience it directly. By understanding the concept well, students will support good self-efficacy (Suryaratri et al., 2022).

Self-efficacy is an individual's belief or self-confidence regarding his ability to organize, carry out a task, achieve a goal, produce something and implement actions to achieve certain skills (Saka et al., 2016). This affective ability aims to grow and instill self-confidence in students. Self-confidence in students is important to be able to support the application of teaching materials (Erlina et al., 2022). In meaningful learning, students are expected to be able to apply it in everyday life. In global warming material, students can find out the causes, impacts and solutions of global warming. Learning media also has an influence on the physics learning process (Rizal et al., 2022).

In recent years, many creative and practical learning media innovations have emerged. One of them is word search. Word search is a learning medium that can be printed or digital. The way word search works is very practical, namely students answer questions by searching for words or sentences in the puzzle correctly (Fitria, 2023). By using word search students will feel interested so that they can increase students' understanding of concepts and self-efficacy. Success in learning physics is supported by several factors, namely the selection of learning models, learning methods, learning media, and assessment instruments (Rizki et al., 2024). In the global warming material, educators must create meaningful learning. Therefore, a good learning strategy is needed. Learning methods that still use conventional methods can make students quickly feel fed up and bored (Puspitarini & Hanif, 2019).

Improving conceptual understanding and self-efficacy in global warming material has significant challenges. Even though this material is quite easy material, meaningful learning to raise students' awareness is still a challenge in itself. Another challenge is missing conception in the form of understanding concepts related to global warming, that global warming only has an impact on increasing air temperature. With the current hot environmental issue, namely global warming, this research will answer questions related to learning the physics of global warming. Researchers used field research methods with quantitative descriptive methods.

This research aims to systematically measure the influence of using the word search inquiry model on students' conceptual understanding and self-efficacy in

global warming material. Thus, the relevant research questions are: (1) What is the feasibility of the teaching module being developed? (2) How does the word search model inquiry influence students' understanding of concepts in global warming material? (3) How does the word search inquiry model influence students' self-efficacy in global warming material?

Method

The research method used is field research with quantitative descriptive methods. The purpose of using this research method is to describe or describe conditions based on obtaining data from the data collection process directly at the research location (Munajah et al., 2023). Apart from that, to be able to find out the effect of using the product being developed on the problems found. The results of field research can be used to encourage change and improvement in educational practice (Gregson, 2020). Research findings can be used to inform educational policies, programs, and practices. The stages of field research can be seen in the Figure 1.

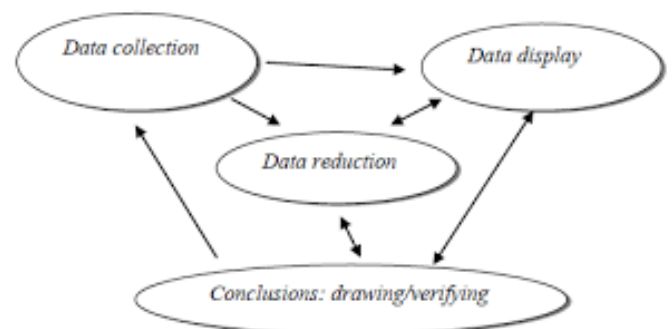


Figure 1. The stages of field research

In this research, the techniques for collecting data were observation, interviews and documentation (Mukhtar et al., 2020). Observation is an effective stage with the process of completing the observation format or form as an instrument (Akbariah et al., 2023; Elfrida et al., 2021). In this research, there are several things that must be considered in observation, including the researcher prepares a format containing items regarding events or behavior to be observed, initial observations are carried out on learning activities in the classroom to be able to identify problems directly in the process of teaching and learning activities, researchers develop products and class action schemes in the form of teaching modules based on the results of initial observations in order to solve problems, test the feasibility of teaching modules to be implemented,

implement teaching modules that are developed, and collection of pre-test and post-test data.

Interview data collection is a data collection technique through conversations with specific aims and purposes from two or more parties (Fenmachi, 2022). The researcher acts as an interviewer, namely asking questions, asking for explanations, evaluating answers, digging deeper into questions, and taking notes. Meanwhile, the school acts as an informant or answers questions and provides explanations of what the researcher asks. In the interview process, the researcher used a research instrument in the form of an interview sheet in the form of written questions that had been planned and arranged in an interview sheet. Documentation aims to complement the process of observation and interview data collection techniques. In this research, documentation takes the form of photo and video archives.

Data analysis is a series of activities for sorting, arranging, grouping, categorizing, and coding or marking with the aim of obtaining findings based on the problem or focus that you want to answer (Velmurugan et al., 2021). In this study, the results of data collection were grouped as primary and secondary data. Secondary data was obtained from documentation while primary data was obtained from interviews and observations.

The data analysis techniques used are data reduction, data presentation and verification. The data reduction process was obtained from interviews with school officials and initial observations (Taupik & Fitria, 2023). Data presentation is carried out with efforts to organize data as a basis for further planning based on the results of interviews and observations (Yantoro et al., 2023). In this research, the data presentation is presented with the results of validation tests for the development of teaching modules based on problems in the process of teaching and learning activities. The final process is verification, namely the data analysis stage resulting from the implementation of the product being developed (Cholilulloh et al., 2023). In this case, the researcher conveys conclusions from the data that has been obtained.

In the process of presenting the data, the results of the validity test of the physics teaching module for class Likert scale analysis is analyzed using the percentage equation for assessing each aspect (Widyastuti, 2022) which can be seen in equation (1).

$$P_i = \frac{\text{Acquisition score}}{\text{Maximum score}} \times 100\% \tag{1}$$

The P_i percentage in equation (1) aims to calculate the weighted average as seen in equation (2).

$$P_i = \frac{\sum n_i P_i}{\sum n_i} = \frac{\sum n_i P_i}{n} \tag{2}$$

with

P_i : percentage of each aspect,

P : weighted average percentage,

n_i : number of questions for each aspect,

n : number of questions.

The classification of feasibility levels and classification of user satisfaction levels can be seen in Table 1.

Table 1. Classification of eligibility levels Description Range

Range	Classification
$0\% < P \leq 25\%$	Very unfit
$25\% < P \leq 50\%$	Less eligible
$50\% < P \leq 75\%$	Eligible
$75\% < P \leq 100\%$	Very eligible

Paired sample t-test is a test of differences between two paired samples (Palimbong et al., 2022). Paired samples are the same subjects, but experience different treatments. This different test model is used to analyze the research model before and after. The paired sample t-test is one of the testing methods used to assess the effectiveness of treatment, characterized by differences in the mean before and the mean after treatment is given (Solahudin, 2022). In this research, paired sample t-test analysis uses SPSS. The paired sample t-test formula can be seen in Equation 3.

$$t = \frac{\bar{D}}{\left(\frac{SD}{\sqrt{N}}\right)} \tag{3}$$

With t the calculated t value, \bar{D} the mean of measurements for samples 1 and 2, SD standard deviation of measurements for samples 1 and 2, and N the number of samples. Then, the calculated t is compared with the t table with a significance level of 95%. The decision making criteria are $T \text{ table} > T \text{ count} = H_0$ is accepted or H_a is rejected $T \text{ table} < T \text{ count} = H_0$ is rejected or H_a is accepted. If the sig value. <0.05 , then there is a significant difference between learning achievement in pre-test and post-test data. And if the sig value. >0.05 then there is no significant difference between learning achievement in pre-test and post-test data.

Results and Discussion

The research began with an interview process with the school, namely the deputy principal for

infrastructure advice and one of the physics teachers at SMA N 1 Bantul. The interview with the deputy principal for infrastructure aims to find out information related to the facilities, routine activities and programs available at the school (Anshori et al., 2022; Rizky et al., 2022). From the results of interviews with the deputy principal for infrastructure, it was stated that the facilities at the school were very complete, such as adequate classroom and laboratory facilities, the indoor facilities were also very complete, there were projectors in each class and complete practical equipment. Routine activities and programs at school are carried out well. From the results of an interview with one of the physics teachers, it was concluded that in implementing physics learning strategies are needed so that meaningful learning can be conveyed well. Apart from that, researchers also made direct observations through the physics learning process in the classroom.

Observations were carried out in one of the randomly selected classes, namely class XD. The number of students in class XD is 36 students. The results of direct observation found that poor understanding of concepts resulted in low student self-confidence. The cause of the problem is that the learning model still uses the teacher center learning model, so a learning model is needed that can increase students' understanding of concepts and self-efficacy. The appropriate learning model based on the results of observations and interviews is using the inquiry learning model. Apart from that, there is a lack of innovative formative assessment media. The cause of the problem is that the media product used still uses conventional assessment media. So interesting media is needed to support learning in class, one of which is using word search. Interviews and observations were carried out in April 2024.

From the results of interviews and observations, researchers developed a class X physics teaching module on global warming with word search. Word searches are made using the Crossword Puzzle (TTS) maker. The website has several choices of TTS forms, in this study word search was chosen. The next stage is designing a word search in Canva. This aims to make the visual

appearance of word search more attractive. The final results of the developed word search display can be seen in Figure 2.

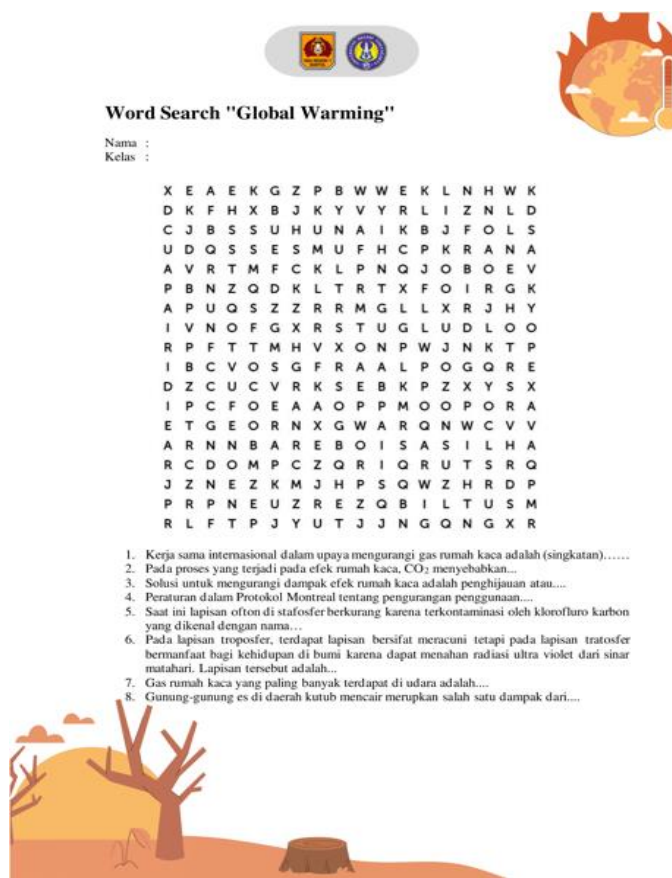


Figure 2. Final result of the word search display

After the manufacturing process was complete, the researchers carried out a feasibility test. The feasibility test was carried out by two validators, namely physics teaching practitioners and physics education master students (Azizah et al., 2023; Yanti et al., 2022). The results of data analysis from the teaching module feasibility test were categorized as very suitable for use with an overall weighted percentage of 91.04%. The results of the teaching module feasibility test can be seen in Table 2.

Table 2. Teaching module feasibility test results

Aspect	Acquisition score	Maximum score	Percentage (%)	Classification
Eligibility contents	38	40	95.00	Very eligible
Surviving	29	32	90.63	Very eligible
Language	7	8	87.50	Very eligible
Weighted average percentage			91.04	Very eligible

In the feasibility test results, the highest percentage was obtained, namely content feasibility of 95.00%, which means that the content in the teaching module is complete. Aspects of content suitability include the

suitability of the material with basic competencies, the suitability of the material with indicators, the suitability of the material with the characteristics of student development, usefulness for students, and the validity

of questions for students about global warming (Isatunada & Haryani, 2021; Tari et al., 2023; Utami et al., 2023). The percentage of presentation and language aspects respectively obtained 90.63% and 87.50%. The two validators who tested the suitability of the teaching module concluded that the teaching module was suitable for use without any improvements. So, the teaching module can be used in physics learning about global warming.

Implementation of learning using the inquiry model begins with a pre-test and ends with a post-test. The learning process takes place in the stages of the inquiry model (Arief & Utari, 2015; Hendri & Setiawan, 2016). Word search work is carried out in groups. Group division was carried out randomly. Learning is active and fun. Students hold discussions together with their group friends. Documentation of the learning process can be seen in Figure 3.



Figure 3. Learning process

In this research, there are two types of student learning achievement that are analyzed, including conceptual understanding and student self-efficacy. The summary results of descriptive statistics from the two samples can be seen in Figure 4 and Figure 5. In Figure 3, the results of descriptive statistical data analysis of students' conceptual understanding are obtained. The average pre-test and post-test scores increased with a pre-test score of 75.33 and a post-test score of 89.66. In Figure 4, the results of descriptive statistical data analysis of student self-efficacy are obtained. The average pre-test and post-test scores increased with a pre-test score of 74.43 and a post-test score of 77.52. The average score for both of them has increased, but the difference in the average score for understanding concepts is greater than for self-efficacy.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRE TEST	75.3333	36	4.65372	.77562
	POST TEST	89.6667	36	3.83219	.63870

Figure 4. Descriptive statistics of concept understanding

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRE TEST	74.4314	36	10.06798	1.67800
	POST TEST	77.5244	36	9.05538	1.50923

Figure 5. Descriptive statistics of self-efficacy

Correlation analysis between the two samples or pre-test and post-test data on conceptual understanding and self-efficacy obtained a sig value. (2-tailed) of 0.00 < 0.05, so it can be concluded that there is a real or significant difference between learning outcomes (understanding of concepts and self-efficacy) in the pre-test and post-test data. In this study, no analysis was carried out on the correlation between types of student achievement or it could also be interpreted as only measuring the influence of each type of student achievement on each student's pre-test and post-test results. The results of the correlation analysis of concept understanding and self-efficacy can be seen respectively in Figure 6 and Figure 7.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRE TEST & POST TEST	36	.686	.000

Paired Samples Test									
Paired Differences									
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	PRE TEST - POST TEST	-14.33333	3.44757	.57459	-15.49982	-13.16684	-24.945	35	.000

Figure 6. Results of correlation analysis of concept understanding

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRE TEST & POST TEST	36	.814	.000

Paired Samples Test									
Paired Differences									
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	PRE TEST - POST TEST	-3.09306	5.90599	.98433	-5.09135	-1.09476	-3.142	35	.003

Figure 7. Results of self-efficacy correlation analysis

Conclusion

This research concludes that the development of a word search inquiry model for conceptual understanding and self-efficacy in global warming material is very suitable for use in the physics learning process with a percentage of 91.04%. The influence of the

word search inquiry model on conceptual understanding and self-efficacy in global warming material has a sig value. $0.000 < 0.05$ so it can be concluded that the product development in this research has a significant influence on the conceptual understanding and self-efficacy of class XD students at SMA N 1 Bantul.

Acknowledgments

Researchers would like to thank Mr. Suyanta, S.Pd. as a companion teacher and physics teacher at SMA N 1 Bantul who has guided and provided direction to researchers in this research process. The researcher also gives his deepest appreciation to the entire academic community of SMA N 1 Bantul who were very supportive and helped launch this research activity.

Author Contributions

Funding

This research was funded by Beasiswa Unggulan (Kementerian Pendidikan, Budaya, Riset, dan Teknologi Republik Indonesia).

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