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The Effectiveness of the Games Based Learning Model Using LUAK Game Media (Physics Kid's Ludo) on Understanding Concepts in the Material on Climate Change and Global Warming

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Abstract. This study aims to improve students' conceptual understanding by implementing a game based learning model using the LUAK (Ludonya Anak Fisika) game media on climate change and global warming material. Concept understanding data were collected through a test using a pre-experimental method with a One Group Pretest-Posttest design involving one class in class X with a total of 36 students, but the researcher only used 32 students because 4 students had other roles to help researchers in conducting treatment in class. Then the data analysis techniques used were N-Gain analysis and effect size analysis. Hypothesis testing used normality test, homogeneity test, and Wilcoxon test (non-parametric test). The results showed that the class that applied the game based learning model using the LUAK (Ludonya Anak Fisika) game media had an N-Gain value of understanding ability of <g> = 0.54 which was included in the moderate category. Meanwhile, the calculation result of Effect Size of understanding ability with a value of 2.22 which is included in the very high category. Thus, the application of game based learning model is considered effective for understanding ability in climate change and global warming material. Additionally, students provided positive feedback after using this game-based learning model.

Keywords: effectiveness, game based learning model, concept understanding

1. Introduction

Climate change and global warming are things that are being observed and anticipated for the past 65 years. Where the main cause of global warming is greenhouse gases, such as carbon dioxide, methane, and nitrous oxide, which absorb and trap heat from sunlight in the atmosphere, causing an increase in the Earth's temperature [1]. To create positive activities in minimizing the impact of global warming, human awareness is very important. This awareness allows humans to recognize and understand their own feelings and behaviors towards environmental problems. Human awareness involves thoughts, attitudes, and behaviors that can be developed through learning and habituation [2]. Increasing awareness can be applied through environmental education in elementary and secondary schools[3][4][5]. Global warming has become one of the materials taught in various countries, including Indonesia, where global warming material is taught from elementary to high school, with special emphasis at the high school level, such as in Physics subjects for class XI semester 2 [6]. The Indonesian education curriculum, especially the 2013 Curriculum, pays special attention to global warming, reflected in the basic competencies of physics subjects for class XI SMA/MA semester II, K.D 3.12 which discusses the symptoms and their impacts on life and the environment. In addition, the emphasis on global warming is also found in K.D 4.12 which directs students to submit ideas or concepts for solving the problem. Meanwhile, in the independent curriculum, global warming material is in phase E

for class X semester 2. Where to obtain good student awareness, successful education is needed or learning can be said to be successful if there is meaningfulness achieved by students, both material and meaningful for their own lives [7]. This means that students must have an essential understanding of climate change and global warming material to increase environmental awareness.

Then based on the results of an unstructured interview with one of the high school students in Subang Regency, it was revealed that the awareness of students at school was considered quite lacking. This was stated on the grounds that there were still many students who littered, both in class and in the school environment. Other lack of awareness such as the use of plastic waste for disposable drinks was also often seen, so that few students brought tumblers or drinking water containers to school. This statement is supported by the results of an interview with a class X physics teacher who revealed that the learning process on the global warming material was only carried out by presenting the material without practicing activities as an effort to make students aware of the importance of the environment in minimizing the impact of global warming. Because the essence of learning is not conveyed, students are also less able to understand the importance of the global warming phenomenon, this causes a lack of student concern for the environment. This is reinforced by the identification of understanding of physics concepts in global warming material, which obtained an average result of 56%. The average results show that the predicate is very poor for 16 students, the predicate is less for 15 students, the predicate is sufficient for 3 students and there are no students with the predicate good and very good. Based on this research, it shows that students' conceptual understanding of global warming material is still lacking and really needs to be improved [8].

Therefore, teachers must find other ways to teach the material so that it becomes something that is remembered and built awareness. In packaging interesting learning, it can be varied by using teaching models. One of the learning models that has characteristics that can support students to be active in learning and create more memorable learning is the game based learning model. The game based learning model is a game-based learning model which is a learning model that applies several educational, fun, and game components in the learning process so as to create a comfortable, fun, and active learning atmosphere [9]. In addition, there are also research results that show that the game based learning model is designed to be able to provide a positive impact on conceptual understanding, learning motivation, student involvement, and positive attitudes towards learning [10]. This further supports that the game based learning model is able to direct students to increase conceptual understanding of a material being studied. In practicing conceptual understanding through the game based learning model, there are 6 stages of learning, namely (1) choosing a game according to the topic, (2) explaining the concept, (3) rules, (4) playing games, (5) summarizing knowledge, (6) reflecting [11].

Another study on the game-based learning model yielded different results. Where in the application of the game-based learning model, students obtain a low level of ability. This happens because of several problems, one of which is that teachers use game-based learning individually, so that only a few students play an active role in competing to solve problems given by the teacher. Then for the actions that need to be implemented to overcome this, there is a suggestion from the researcher to form small groups so that students can collaborate with their peers [12]. Therefore, in the game-based learning model activity, it is necessary to form groups so that each student can be active and more easily gain an understanding of the concepts in the material taught by collaborating or discussing.

Then in the game based learning model, it is also inseparable from the role of learning media. Learning media is a tool that can be used by students to make it easier for students to understand the material well [13]. Media can be various, one that can be combined in the game based learning model is the ludo game. Ludo is a traditional game played by 2-4 people who are required to determine the strategy used in moving 4 pawn pieces using dice [14]. However, the game can also be modified to facilitate group learning, by using several supporting components so that students are directly involved in using the media [15]. This is in line with the suggestions of previous research results regarding the game based learning model which requires the formation of groups. Therefore, ludo can be said to be suitable because it can be played in groups.

Therefore, the author tries to implement a game based learning model using a modified ludo game media called LUAK, namely Ludonya Anak Fisika. Where this ludo game is carried out in groups so that students can collaborate. So that it can give meaning to a good understanding of the concept of the material presented. The material chosen by the researcher is climate change and global warming at the high school level. The purpose of this study was to analyze the effectiveness of the learning model, namely game based learning, which is reviewed from the understanding of concepts in climate change and global warming materials.

2. Method

This type of research is quantitative research with a pre-experimental design, namely one group pretest-posttest. The one group pretest-posttest research design was carried out by researchers in providing treatment using the game based learning model as an independent variable and conceptual understanding as a dependent variable. Furthermore, after the treatment was completed, the researcher gave a posttest. The One Group Pretest-Posttest research design can be seen in Table 1.

Table 1. One Grup Research Design (Pretest dan Posttest)

Pretest	Treatment	Posttest
O_1	X	O_2

The initial test (O1) was conducted before the learning process using the game-based learning model with the Luak game media (Ludonya Anak Fisika). The treatment (X) involved implementing the game-based learning model, utilizing the Luak game media. Finally, the posttest (O2) was administered after the learning process, once again using the game-based learning model with the Luak game media [16].

The population in this study was to choose one class in class X of high school with a total of 36 students, but the researcher only used 32 students because 4 students had other roles to help the researcher in conducting treatment in class. Then the material to be taught is Climate Change and Global Warming in one of the high schools in Subang Regency. The instruments used by the researcher consist of two types, namely learning device instruments and data collection instruments. The learning device instrument consists of teaching modules and LKPD (Student Worksheets). Furthermore, the data collection instrument consists of a concept understanding test, a game-based learning model implementation sheet, and a student response questionnaire to the game-based learning model. Data testing uses normality tests, homogeneity tests, and Wilcoxon tests (non-parametric). The next step is to test the contents of an instrument with validity and reliability tests, with observers or expert judgments, the test is carried out by three physics lecturers and two physics teachers. The results of the data from expert judgment use Aiken's validity using the Aiken validation coefficient. Then it was processed using Rasch modeling analysis and using Ministep software version 4.8.2.

To determine the effectiveness of the game based learning model using the LUAK game media (Ludonya Anak Fisika) on understanding, the researcher used N-Gain analysis and effect size analysis. Where the N-Gain analysis is to see the increase in learning outcomes before and after through the pretest and posttest results. Meanwhile, the effect size is used in this study with the aim of seeing how much influence there is between variables on other variables. So this test is carried out to measure how much influence there is between the game based learning model using the luak game media (Ludonya Anak Fisika) on understanding the concept of climate change and global warming materia.

The game media used in this learning activity is Ludo. The following is an image of the standard Ludo game shown in Figure 1. In the rules of the Ludo game, each player represents a color group, which can be one of the following colors: red, yellow, green, or blue.

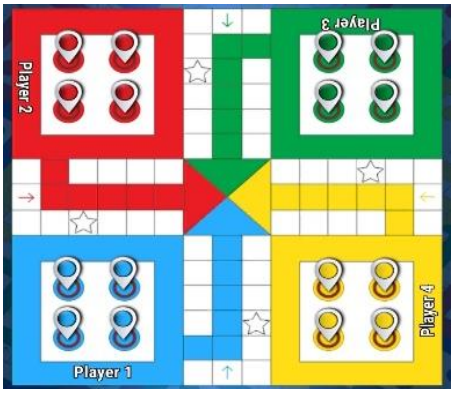

Figure 1. Standard Ludo.

This conceptual understanding test data is in the form of multiple choices totaling 15 questions. The following is the number of test questions against the conceptual understanding indicators given.

Table 2. Number of Test Questions against Concept Understanding Indicators.

Concept Understanding Indicator	Question Number	Total Questions
Exemplifying	1,2	2
Inferring	3,4	2
Explaining	5,6	2
Interpreting	7,8	2
Comparing	9,10	2
Classifying	11,12	2
Summarizing	13,14,15	3
Total Questions on Conceptual Understanding Test		15

3. Result and Discussion

3.1. *Result*

Furthermore, there are quite diverse results of the students' understanding test, with the lowest pretest score being 13 and the highest pretest score being 66. Then for the lowest posttest score being 60 and the highest posttest score being 93. If a bar chart is made between the pretest and posttest scores, it is as follows.

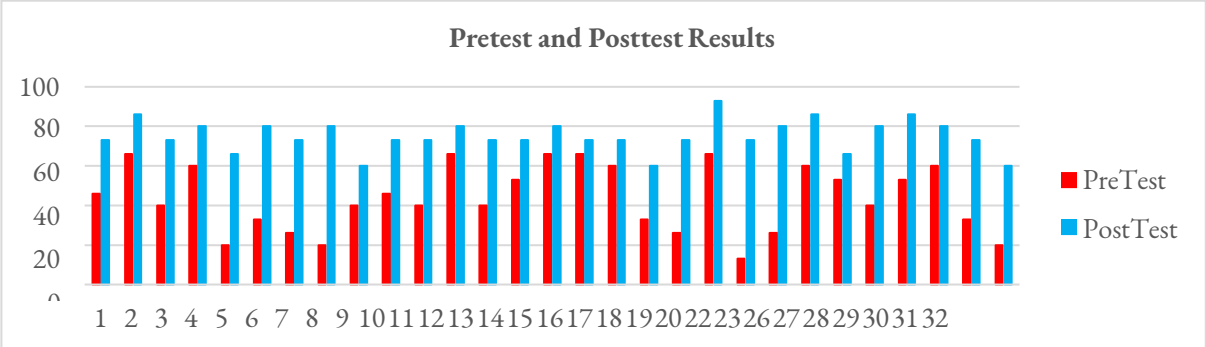

Figure 2. Pretest and Posttest results.

After knowing the results of the pretest and posttest values, an analysis of the normality test, homogeneity test and Wilcoxon test (non-parametric) was carried out. The reason the researcher used the Wilcoxon test (non-parametric) was that the researcher had data that was not normally distributed and did not meet the homogeneity assumption, so the next step could be to consider using non-parametric statistics. The results of the Wilcoxon test (non-parametric) are as follows in Figure 3.

Test Statistics[a]

	postest - pretest
Z	-4,947[b]
Asymp. Sig. (2-tailed)	,000

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Figure 3. Wilcoxon test results.

Then the effort shows the influence of the use of game based learning models on conceptual understanding. To find out more details about the increase in conceptual understanding can be seen through the results of the N-Gain analysis. The following is a recapitulation of the N-Gain results of the overall student conceptual understanding scores presented in table 3.

Table 3. N-Gain value of conceptual understanding.

Average Value			Category
Pretest	Posttest	N-Gain	
44,03	74,93	0,54	Currently

To obtain the N-Gain value, the average pretest and posttest values are required. The researcher obtained an average pretest value of 43.75 and an average posttest value of 74.91. Then the researcher conducted an analysis, thus obtaining an N-Gain value of 0.54. Based on the interpretation of the N-Gain value, the value of 0.54 is included in the interpretation of $0.70 > \langle g \rangle \geq 0.30$ so that it obtains a moderate category.

Then in knowing the effectiveness of a learning model on the concept understanding test, it can be analyzed from the effect size. This aims to allow researchers to see how much influence and effectiveness there is between variables on other variables. The following is a recapitulation of the results of the effect size of the overall concept understanding scores of students presented in table 4.

Table 4. Effect size value of students' concept understanding.

Average Value		Standard Deviation		Combined Standard Deviation	Effect Size Value
Pretest	Posttest	Pretest	Posttest		
44,03	74,93	15,62	7,46	12,24	0,252

In the table above to obtain the effect size value, it is necessary to have data on the average pretest and posttest values and the combined standard deviation obtained from the variance values of the pretest and posttest scores. Then after being analyzed, the effect size value is obtained as much as 0.252. Based on the interpretation of the effect size value, the value of 0.252 is included in the interpretation of 0.2 <d <0.8 so that it obtains a moderate category.

In addition to observing learning outcomes, this study also involves observations based on student responses to the game-based learning model using the LUAK (Ludonya Anak Fisika) game media on understanding concepts in climate change and global warming materials, using a questionnaire. The contents of the response questionnaire contain 20 questions, with questions having positive and negative statements. Then if entered into an assessment scale using a Likert scale (1-4). The recapitulation of answers to positive and negative question statements is in Table 5.

Table 5. Percentage scale calculation results.

Positive			Negative		
Option	Scale	Score	Option	Scale	Score
SS	4	252	SS	1	16
ST	3	89	ST	2	64
TS	2	136	TS	3	123
STS	1	35	STS	4	156
Percentage Score		77,2%	Percentage Score		70,1%
Category		Positive	Category		Positive

The data shows that the percentage of positive question scores is 77.2% and the percentage of negative question scores is 70.1%. Both scores are included in the positive interpretation. This shows that students have a good or positive response to the treatment or treatment of the game based learning model given in class.

3.2 *Discussion*

The difference between the findings obtained by the author and previous publications conducted by other researchers. In a study by Ulfa, et al. (2022) conducted a game-based learning model by means of students doing it individually, so that the essence of making students active in this learning model was less than optimal [12]. Therefore, the previous researcher gave suggestions to divide them into groups so that students could collaborate. Then based on the findings obtained by the researcher based on suggestions from previous studies. By using a game-based learning model assisted by ludo media that has been modified by the researcher, the influence of the N-Gain test results was in the moderate category. This means that there is an influence from the treatment that the researcher has carried out and the influence is considered moderate. Furthermore, to obtain effectiveness, the researcher has results in the moderate category too. Therefore, this treatment or learning using a game-based learning model using the LUAK (Ludonya Anak Fisika) game media on understanding concepts in the material on climate change and global warming can be used again in learning, especially regarding understanding concepts. This is in line with research conducted by Paulina (2023) regarding the game- based learning model, one of which has an impact on improving students' conceptual understanding [10]. The study revealed that the game-based learning model has the potential to be a very effective tool in improving students' conceptual understanding [17] [18] [19].

Game based learning is a promising learning model to improve conceptual understanding [20] [21]. However, to be able to support high success with the game based learning model, it is necessary to pay attention to suitable media or the selection of appropriate games. In line with this, in the study of the game based learning model using the LUAK (Ludonya Anak Fisika) game media on conceptual understanding of climate change and global warming materials, it received good or positive responses from students through questionnaires. There were several notes written by students when filling out the response questionnaire, namely that students felt happy, learning felt more exciting, not bored, became something new in learning, and many other positive things expressed by students in the questionnaire notes. In the questionnaire, the researcher emphasized several indicators of understanding the concepts taught and also received good responses from students. Therefore, based on the explanation above, the game based learning model using the LUAK (Ludonya Anak Fisika) game media has met the needs of students to practice conceptual understanding of climate change and global warming materials.

4. Conclusion

Based on the research results obtained from the results of data analysis, it can be concluded that the game based learning model using the LUAK (Ludonya Anak Fisika) game media can improve conceptual understanding of climate change and global warming materials in the very high category. Furthermore, the responses of students after following the game based learning model using the LUAK (Ludonya Anak Fisika) game media are included in the positive category. This shows that what the researcher did in implementing the game based learning model in the classroom was good. The suggestion from the researcher is to find a game that minimizes the expenditure of a lot of time. This can be done by modifying the technical aspects of the game. Then for further research, you can look for a game that is famous or already known by students to make it easier for students to play while learning.

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