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Predict-Observe-Explain Learning Model Assisted by "Educandy" Games to Improve Students' Conceptual Understanding

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Abstract

A good understanding of concepts is needed to prevent students from misunderstanding. One effort that can be done is to apply the POE (Predict-Observe-Explain) learning model with the help of the Educandy educational game. This study aims to measure the effect of applying the POE learning model with the help of Educandy educational game application to increase students' conceptual understanding of temperature and heat subjects. This study was quasi-experimental design research, using the nonequivalent control group design. The population of this study was 128 junior high schools students of SMPN 25 Pekanbaru (Class VII.I-Class VII.4). The first class, VII.1, was used as the experimental class, the third class, VII.3, was used as the control class, while the other class was the generalization classes. Research instrument of pretest and post-test containing 28 questions was used. The result was processed by descriptive and interferential techniques using T-test. The data processing technique used was descriptive and inferential, using the t-test for N-gain as an evaluation method. The results of this study indicated that conceptual understanding in both classes had increased, but the average value of students' conceptual understanding in the experimental class was higher than that in the control class. It was described on the data N-gain as 0.7 in the experiment and 0.3 in the control class. The results of the t-test show that the POE learning model assisted by educational games based on the Educandy application can significantly improve students' understanding of concepts.

Keywords: learning model, Educandy, game, conceptual understanding, predict-observe-explain

INTRODUCTION

The learning process is defined as transforming knowledge between teachers and students in which there is a combination of various elements and processes ranging from setting goals, and developing learning resources to implementing learning strategies (Munna & Kalam 2021). Appropriate learning strategies are an important dimension for encouraging initiative and ease of student learning (Churces 2010). The selection of an effective learning strategy is an effort to improve results (Muharikah, Karnalim & Natsir 2022).

The learning process that has occurred so far has not optimally developed students' thinking abilities. The implementation of the learning process that is currently taking place is directed at students

memorizing information and practicing the questions presented. Learners are trained to remember and hoard information without being required to digest and understand the meaning contained therein, thus learning is still unable to involve students. Therefore we need a learning process that can make students understand science concepts well in developing their ability to understand concepts (Al Ansi & Garad 2021). Traditional learning is one of the causes of problems in the perception and practice of learning science (Chandra, Khairudin & Hertanto 2017). The low condition of students' learning motivation causing a decreased in students' understanding of concepts and learning outcomes. The low understanding of students' concepts has a negative impact on subsequent scientific concepts and can lead to misconceptions (Furqani, Feranie & Winarno 2018).

During the pandemic that occurred for about two years, there was a change in learning which was initially carried out face-to-face to distance learning, one of which was using online mode)Sari, Hasan & Mahidin 2020). Learning changes like this are one of the causes of a decrease in learning motivation (Zakiyah, Widodo & Tukiran 2019). Currently, Indonesia is in a post-pandemic period where students who are accustomed to carrying out online learning are changed back to limited face-to-face learning.

Referring to this problem, the teacher needs to make innovations in learning according to Students' needs, consider the learning environment's needs, and continuously improve the learning process. Moreover, teachers must be up to date with current technological developments and must also master relevant applications to attract students' interest and motivation in learning (Zakiyah, Widodo & Tukiran 2019). Innovations such as hybrid learning (Fitriati, Purnamasari 2021) and ICT-based learning (Muna 2017) are some of the post-pandemic learning solutions in Indonesia.

One learning model that is able to facilitate students' ability development optimally is the Predict-Observe-Explain (POE) learning model. The POE learning model includes instructions that teachers can use to help students improve their conceptual understanding as well as psychomotor. The POE learning model is an efficient tool for creating student discussions about scientific concepts (Muna 2017). This strategy involves students in predicting a phenomenon, making observations through demonstrations or experiments, and finally explaining the results of the demonstration and their previous predictions. In this way, the concepts students get will stick in their memories, and students will understand what they learn (Kibirige, Osodo & Tlala 2014).

Another effort used is to apply learning media. Learning media is contained in the teaching method component to strengthen the interaction between teachers, students, and their learning environment. Learning media can assist students in increasing understanding, presenting data in an interesting and accurate manner, facilitating the interpretation of data, and condensing information. Learning media can be interpreted as a supporting tool to achieve learning goals effectively and efficiently. Besides that, it can also increase student learning motivation (Dunlosky, Rawson 2013). Games as learning media can make the learning atmosphere more enjoyable and reduce boredom with the information or material conveyed by the teacher to students. Games created as learning media are expected to have an impact on active learning students during the learning process (Fatkhurrokhman, Leksono 2018).

There are several advantages of educational games compared to conventional educational methods. One of the educational games' main strengths is the visualization of real problems. The use of applications or platforms in learning is one way to make learning more fun and not monotonous. Besides that, making game-based quizzes allows students to play while still learning, so it's not easy to make it (Restani 2019). Educandy is a web-based application that has the slogan 'making learning sweeter'. Educandy can be used to make online games that are fun and still in the context of learning. With the Educandy application, the teacher can design and create question banks related to the subjects being taught during learning so that later it can be used again when the teacher evaluates both of quizzes or practice. Interesting and interactive evaluations help students grow interested and enthusiasm in working on questions (Ulya 2021).

The novelty of this research is that the application of the POE model used does not stand alone, in practice, the POE model is assisted by using Educandy games to carry out the learning exercises. The characteristics of Educandy are most suitable for used learning terms or concepts, making it easier for students to memorize the correct concepts. While observing activities, constructing concepts from the results of observations, and explaining the results of observations support students in understanding a concept well. So this combination of models and educational games helps students memorize and understand a concept. Correct understanding of a concept in preventing students from misconceptions.

The purpose of this study was to apply the POE model with the help of Educandy games in increasing junior high school students' conceptual understanding of temperature and heat.

METHODS

This research is quasi-experimental, using the nonequivalent control group design according to Sugiyono (2015), as shown in TABLE 1.

TABLE 1. Nonequivalent Control Group Design

Class		Treatment
Eksperiment	:	O_1 X O_2
Control	:	O_3 - O_4

As shown in TABLE 1, O_1 is the condition of the experimental class before being given treatment, O_3 is the condition of the control class before treatment. Both classes, before being given treatment, were homogeneous, that's mean all of the participants started with the same conditions. X was represented the treatment given to classes. The experimental class is the class that is treated with POE model assisted by Educandy games while the control class uses conventional learning where learning is carried out using a scientific approach and lectures.

Population of this study was 128 grade 7th students junior high school of SMPN 25 Pekanbaru (Class VII.I-Class VII.4). The first class, VII.1, was used as the experimental class, the third class, VII.3, was used as the control class, while the other class was the generalization classes. This study used a random sampling technique in which the control class and the experimental class were obtained from the results of the homogeneity and normality tests obtained from the pretest results processed using SPSS 22. The research was carried out from September to December 2021. Research data was collected by giving a test in the form of a pretest and post-test, totaling 28 questions with indicators of understanding concepts as shown in TABLE 2.

TABLE 2. Concept Understanding Indicators

No.	Concept Understanding Indictors	Questions	The number of questions
1.	Classifying	4	4, 12, 16, 23
2.	Interpretation	4	8, 11, 20, 25
3.	Give an example	4	7, 14, 15, 21
4.	Inferential	4	1, 17, 18, 19
5.	Compare	4	10, 13, 27, 28
6.	Explain	4	2, 3, 9, 24
7.	Generalization	4	5, 6, 22, 26
Questions			28

The data analysis technique used is descriptive and inferential analysis. Descriptive analysis by looking at the effectiveness of n-gain learning and development. We can see the category of learning effectiveness in understanding students' concepts in TABLE 3.

TABLE 3. Concept understanding categories (Sri 2019)

Interval of concepts understanding scores (%)	Understanding Categories	Effectiveness Categories
85-100	Very Good	Very effective
70-84	Good	Effective
50-69	Good Enough	Effective enough
0-49	Not Good	Less effective

The average score includes pretest scores and post-test scores from the average score of each indicator in understanding of the concept and the overall average score. The pretest and post-test scores used to determine the gain score are as follows:

$$Ngain\ score = \frac{Pretest\ scores - Postest\ Scores}{Maximums\ scores - Pretest\ Scores}\ x\ 100\% \quad (1)$$

Obtaining n-gain scores for students' understanding of concepts is grouped into three categories based on TABLE 4.

TABLE 4. N-Gain Score Categories (Lina et al. 2019)

N-Gain Score %	Categories
$0{,}70 < (Skor\ n-gain)$	High
$0{,}30 \leq (Skor\ n-gain) \leq 0{,}70$	Middle
$(N-gain\ Score) < 0{,}30$	Low

Inferential used in this study was the Kolmogorov Smirnov test technique for the normality test and the One-way ANOVA technique for the homogeneity test, where both of these tests were assisted by SPSS 22. Statistical analysis after treatment was carried out using Paired sample test. In independent t-test with the hypothesis, H0 = There is no significant difference of students' understanding between the experimental class and the control class after treatment. The significance level used was 5%

RESULTS AND DISCUSSION

In this study, both classes were tested through a pretest and post-test. Data from pretest and post-test results obtained data on students' conceptual understanding before and after being given treatment in the form of a POE learning model assisted by educational games based on the Educandy application. Data from the pretest and post-test statistical results of the two classes can be seen in FIGURE 1.

	N	Mean	Std. Deviation	Std. Error	95% Conficence Interval for Mean Lower Bound	95% Conficence Interval for Mean Upper Bound	Minimun	Maximum
Experiment	29	32.017	7.9015	1.4673	29.012	35.023	14.3	46.4
Control	27	31.874	9.4846	1.8253	28.122	35.626	10.7	46.4
Total	56	31.948	8.6206	1.1520	29.640	34.257	10.7	46.4

Levene Statistic	df1	df2	Sig.
.625	1	54	.433

FIGURE 1 The SPSS results obtained from the value of students' understanding of the concept.

FIGURE 1 shows the SPSS results obtained from the value of students' understanding of the concept. Students' understanding of concepts in both the experimental and control classes had an average score of almost the same understanding of concepts, namely 32.01 for the experimental class and 31.88 for the control class. The standard deviation for each class is not much different, namely 7.9015 for the experimental class and 9.4846 for the control class. The control and experimental classes had the highest score, namely 46.4. The results of the homogeneity test for the two classes show that the two classes are homogeneous with a decision making $\alpha < 0.05$.

The treatment in the form of a POE model assisted by Educandy games was carried out in the experimental class while the control class was given conventional learning. To see the improvement and Concept's understanding between those who were given treatment and those who were not, a post-test was carried in both classes. The results of the post-test that have been carried out show a of increased understanding of concepts before and after learning. FIGURE 2 shows the results of the comparison of students' pretest and post-test in the experimental class.

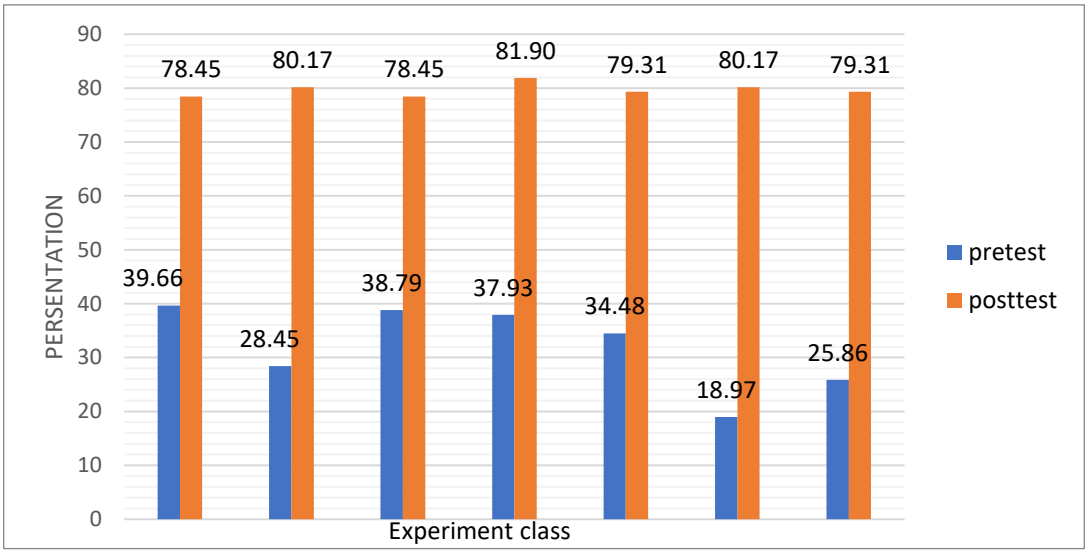

FIGURE 2. Score of pretest and post-test on experiment class

Based on FIGURE 2, it can be seen that each indicator of conceptual understanding in the experimental class has increased. Overall the average score of concept's understanding before and after the implementation of the POE learning model assisted by educational games based on the educandy application has increased from a score of 32.02 which was in the category of not good to 79.31 and was in the category of good understanding.

Understanding of students' concepts in the control class also increased. The score obtained by students in the control class is in the good enough category. Comparison of student pretest and post-test scores is shown in FIGURE 3.

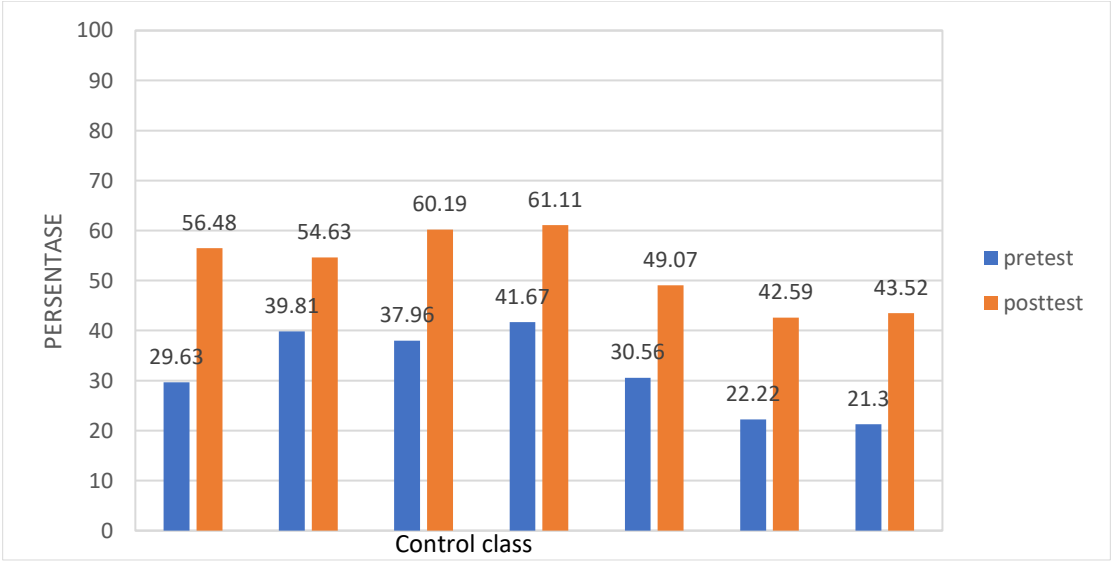

FIGURE 3. Score pretest and post-test on control class

In FIGURE 3 it can be seen that there is an increase in the score of each indicator of understanding the concept in the control class. Overall the average score of the control class in increase from a score of 31.88 which was in the not good category to 52.51 which was in the good enough category after the application of conventional learning. Analysis of increasing concept's understanding for each indicator using n-gain can be seen in TABLE 5.

TABLE 5. Analysis results of increasing understanding of the concept of each indicator

No	Concept understanding indicators	Experiment				Control			
		Pre test (%)	*Post test* (%)	*N-gain*	Category	*Pre test* (%)	*Post test* (%)	*N-gain*	Category
1	Interpretation	39.66	78.45	0.64	M	29.63	56.48	0.38	M
2	Give an example	28.45	80.17	0.72	H	39.81	54.63	0.25	L
3	Clarifying	38.79	78.45	0.65	M	37.96	60.19	0.36	M
4	Generalize	37.93	81.90	0.71	H	41.67	61.11	0.33	M
5	Inferensi	34.48	79.31	0.68	M	30.56	49.07	0.27	L
6	Comparing	18.97	80.17	0.76	H	22.22	42.59	0.26	R
7	Explain	25.86	79.31	0.72	H	21.30	43.52	0.28	R
	Average	32.02	79.68	0.70	S	31.88	52.51	0.30	S

TABLE 5 shows that the n-gain score for each indicator of understanding the concept of the experimental class is higher than the control class where the experimental class obtains N-gain values for the indicators exemplifying, generalizing, comparing and explaining respectively 0.72, 0.71 , 0.76, and 0.72 which all fall into the high category and the N-gain values on the interpretation, clarifying and inference indicators are 0.64, 0.65 and 0.68 respectively in the medium category. Whereas the control class on the interpretation, clarifying, and generalizing indicators obtained N-gain values of 0.38, 0.36 and 0.33 which all belonged to middle category and the indicators of exemplifying, inferring, comparing and explaining were in the low category with a value of N -gain 0.25 , 0.27 , 0.26 and 0.28.

There are also differences in the average score of N-gain obtained in both classes. The experimental class obtained an average score of 0.70 which was in middle category and the control class obtained an n-gain value of 0.30 which was in the medium category. Thus, the experimental class has highet N-gain average from the control class, but they belong to the same category which is moderate. Comparison of the increase obtained by the experimental class and the control class can be seen in FIGURE 4.

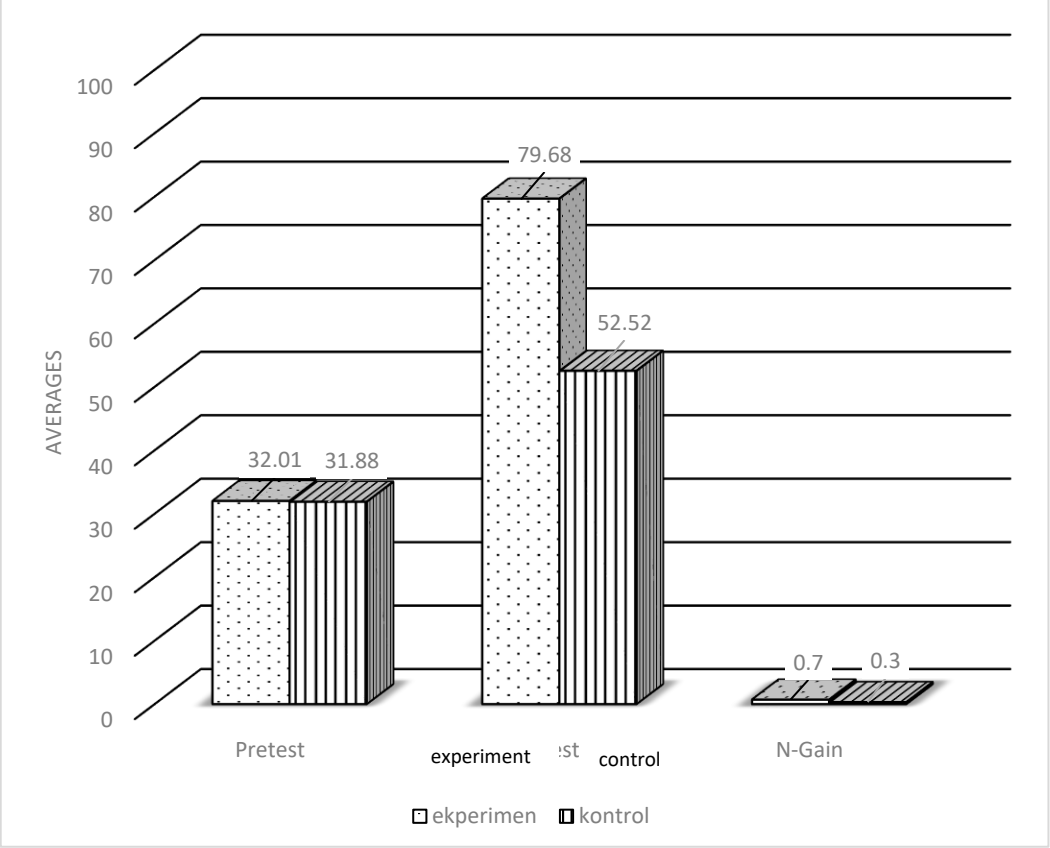

FIGURE 4. Comparison of Control and Experiment Class Concept Understanding Scores at Pretest and Post-test

Based on the n-gain value, the increase in conceptual understanding in the experimental class that applied the POE learning model assisted by educational games was higher than the control class which applied conventional learning methods. Inferential analysis with the help of SPSS 22 on the average score of students' understanding of concepts before and after the implementation of both the experimental class and the control class can be seen in FIGURE 5.

		Paired Differences					t	df	Sig.(2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Interval of the Lower	Upper			
Pair 1	Pretest-Posttest	-47.6655	8.0544	1.4957	-50.7292	-44.6018	-31.869	28	.000

FIGURE 5. The output of the Paired Sample T-Test in the experimental class

The results of the t-test for the pretest and post-test values of the experimental class show that the significance level is 0.00, this means that α_count <0.05. Based on the method of drawing conclusions, it was found that the application of the POE model with the help of educandy games can improve students' understanding of concepts significantly. The results of statistical calculations for the control class can be seen in FIGURE 6.

		Paired Sample Test					t	df	Sig.(2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Interval of the Lower	Upper			
Pair 1	Pretest-Posttest	-34.9296	73.3539	14.117	-63/9475	-5.9118	-2.474	26	.020

FIGURE 6. The output of the Paired Sample T-Test in the control class

The control class also obtained the same conclusions as the experimental class where the application of conventional learning (learning using a scientific approach and lectures) could also improve students' understanding of concepts where the resulting significance level was 0.02 so that α_count <0.05. In both the experimental and control classes, the significance level values were 0.000 and 0.020, respectively, which means H_0 was rejected, so it was stated that there was a significant difference in the average value of conceptual understanding between before and after learning in the control class and the experimental class. Hypothesis testing was carried out using the Independent Sample t-test and was obtained as shown in FIGURE 7 below.

		Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Understanding Concept Scores	Equal Variances Assumed	17.474	.000	11.960	54	.000	27.1687	2.2716	22.6145	31.7230
	Equal Variances not Assumed			11.684	36.228	.000	27.1687	2.3253	22.4538	31.8836

FIGURE 7. *Output* of *Independent Sampel t-test*

Based on the output with the Independent Sample t-test in FIGURE 7, it can be seen that the t-test results obtained a significant value (sig, 2-tailed) after being given treatment between the control and experimental classes which was 0.000. Where the significance of $\rho < 0.05$ or $0.000 < 0.05$ then H0 is rejected, which means that there is a significant difference between the average value of understanding the concept of the experimental class and the control class. Differences in the results of understanding the concepts of students who apply the POE learning model assisted by educational games based on educandy applications and classes that apply conventional learning can be seen in TABLE 1. 4 where the average understanding of students' concepts in the experimental class is higher and better than the control class.

The cognitive process of understanding concepts consists of the ability to interpret, exemplify, clarify, generalize, infer, compare, and explain. There are seven indicators of understanding according to Anderson & Krathwhol in (Kholfadina 2022) namely interpretation, exemplifying, classifying, generalizing, inferring, comparing, and explaining. Interpreting is changing information into another form of information, for example changing words into pictures, summarizing, or paraphrasing. Giving an example means showing a phenomenon or a case example of a concept or principle. Classifying means recognizing that something falls into a certain category. Generalizing or summarizing, namely representing all information or making an abstract from a piece of writing. Comparing is an activity of detecting the similarities and differences of two objects, ideas or situations. Inferencing is finding patterns from an example or situation. Explaining means constructing or using a causal model in a system.

The prominent indicators obtained by the experimental class were the ability to give examples, generalize, compare and explain. These four indicators are in the high category. In educandy there are many word games that can be played individually, duels with computers, and duels with friends (Resatami 2019). This educational game in the form of games and duels increases student activity and participation in class. The use of educandy in learning is more about providing a stimulus, increasing student enthusiasm, and making it easier for students to understand the material (Erina Susanti 2021). The use of educandy in learning can be used to help students remember terms, test their understanding of a particular concept, and ice breaking by giving duels between students.

Educational also support students to recall a concept by asking for an explanation of a term or giving terms and asking students to find the right explanation. Therefore educandy games support students in terms of explaining. In educandy games the teacher can name examples of phenomena from a concept, ask students to choose examples from the concept in question, or classify the correct concept in some of the phenomena in question. Moreover games can also be made where students determine the similarities and differences of two phenomena or cases. Because educandy games have more word games or terms, they are very supportive in learning about explaining terms, determining the correct concept or explanation of a concept, giving examples, and comparing.

POE is an alternative learning model that supports an increased understanding of concepts. POE starts by giving a hypothesis proven by the data obtained through observation activities and then discussed in depth (Kala & Yaman 2013). POE has three stages, namely Predict where at this stage the teacher describes a phenomenon and asks students to write down their predictions and reasons why things it can happen (based on their beliefs). The second stage is for students to collect information or data needed to test these predictions through experiments, observations, and so on. In the third stage, students try to understand why their predictions are wrong and explain the new theory they get. This model is better at helping students gain a good understanding of concepts and reduce conceptual errors (Rahayu, Widiyatmoko & Hartono 2015).

Research conducted by (Effendi 2013) shows that POE can help students understand concepts. However, the POE model has limitations where POE may not be suitable for some subjects or topics that require higher-order thinking skills, such as analyzing, evaluating, and creating. If the material topic is general knowledge then the prediction stage runs easily, not the case if what is predicted is a rare case. The observation stage works well for concrete knowledge, but it will be difficult if the knowledge studied is abstract. The explaining stage will go well only if students have good communication skills. When the required cognitive level is higher, the level of thinking is more complex and the use of this model is less effective. (Ratna, Firdiani 2021) found that the POE model was most effective in helping students predict phenomena.

The implication of students obtaining a good understanding of concepts is to minimize misconceptions. The results of the study (Jessani 2015) reveal the use of POE in overcoming misconceptions and identifying misconceptions in students. This is in line with the results of research (Karamustafaoğlu & Mamlok-Naaman 2015) where the result is that POE is effective for teaching concepts and eliminating misconceptions about certain concepts. (Rahayu, Widiyatmoko & Hartono 2015) stated that POE helps students to understand concepts and minimizes the percentage of student misconceptions. Elementary and high school students how to apply the facts and vocabulary they remember in learning science. Many previous studies have shown that students can remember facts and procedures but cannot use them to make arguments, make predictions, and explain observed phenomena. So one effort to connect this is to apply a learning model that supports students to predict, observe, and explain the observed phenomena.

This study shows that both the experimental class and the control class are effective in increasing students' understanding of concepts significantly. Statistical testing of post-test experimental and control classes also showed that significant results were obtained between students' conceptual understanding in the experimental class compared to the control class. The results of this study are in line with the results of research conducted by Puji Rahayu with the title Application of the POE Strategy (Predict-Observe-Explain) with Motede Learning Journals in Science Learning to Improve Understanding of Concepts and Science Process Skills in 2015, namely after implementing the POE learning model of participants students experience an increase in understanding of concepts in the high category (Unicef 2021). The same results were also obtained in research conducted by Rachmad Effendi in 2017 entitled The Effect of the POE (Predict-Observe-Explain) Learning Model on the Understanding of Physics Concepts in Class X Students of SMKN 5 Bandar Lampung on the subject of Calor where he concluded that there was a significant influence the use of the POE learning model for the subject of class X heat of SMKN 5 Bandar Lampung (Puspitarini & Hanif 2019). In addition, research conducted by Meliana Suranti et al in 2018 with the title POE Learning Model (Predict Observe Explain) on Student Learning Outcomes in Vibration and Wave Material, based on statistical tests, it can be concluded that there is an effect of increasing student learning outcomes from using the POE model in vibrations and waves.

CONCLUSION

Based on the results of the research that has been done, it was found that students' conceptual understanding in the experimental class resulted in a higher average than the control class with increased conceptual understanding in the experimental class being in the high category and the control class being in the middle category so that it can be concluded that the POE learning model is assisted Educational games based on the Educandy applicatio

n can improve students' understanding of concepts. The POE model with the help of educandy games supports the improvement of the seven aspects of understanding the concept, and best supports four of the seven components namely explaining, generalizing, exemplifying, and comparing. The aspects of predicting phenomena, observing through demonstrations and experiments, and explaining the results of observations help students understand a concept through the construction process. This is influenced by the characteristics of educational games which basically make it easier for students to remember and understand terms and meanings. The application of educational games based on the Educandy application requires a stable internet connection and also has adequate school facilities if it is to be carried out face-to-face. Research using this application needs to ensure in advance the availability of facilities and connections in the school environment where the trial is conducted.

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