

Advance Organizer Model in Physics Learning

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Submission date: 20-Oct-2019 09:55PM (UTC+0700)

Submission ID: 2078321291

File name: Advance_Organizer_Model_in_Physics_Learning.pdf (1.1M)

Word count: 4708

Character count: 26383

Advance Organizer Model in Physics Learning: Effect Size Test on Learning Activities and Students' Conceptual understanding

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Abstract. This study aims to determine the effectiveness of the Advance Organizer learning model on learning activities and students' conceptual understanding in learning physics. The research method used is a quasi-experimental design with a non-equivalent control group design. The population of this research was the tenth-grade nursing major students of SMK N 7 Bandar Lampung. The sampling technique used was purposive sampling. The instruments employed in this research were the non-test observation questionnaire to measure the students' activity and test in the form of a Three-Tier Diagnostic test to measure student's conceptual understanding. Data obtained were analyzed using the multivariate test (MANOVA). The Advance Organizer learning model is more effective in increasing learning activities and students' conceptual understanding. It is indicated by the value of the effect size of learning activities which is 0.718 and the effect size of the conceptual understanding which is 0.392 in the medium category. Based on the results of the MANOVA test, the significance value of learning activities and conceptual understanding is less than 0.05 ($\text{sig} < 0.05$), so it can be concluded that there is an influence of Advance Organizer learning model toward the learning activities and students' conceptual understanding in physics learning.

Keywords: Advance Organizer learning model, learning activities, conceptual understanding, physics learning.

1. Introduction

The learning activity is an activity done or occurs both physically and non-physically [1]. Student learning activities during the teaching and learning process is one indicator of students' desire to learn [2]. Active learning is a teaching and learning system that emphasizes the activeness of students physically, mentally, intellectually and emotionally to obtain good learning outcomes [3].

Students are active people who have the drive to do something and have their own will and aspirations. So, it can be concluded that learning activities are a whole series of student activities carried out during the learning process that involves physical and psychological activities in understanding the material [1]. Student learning activities are grouped into 8 categories, namely: visual activities, oral activities, listening activities, writing activities, drawing activities, motor activities, mental activities, and emotional activities [4].

Understanding is defined as the ability to absorb and understand the studied learning material [5]. Conceptual understanding is the most important part of the learning process and in solving problems, both in the learning process and in the daily-life [7] Conceptual understanding is indicated by mastering the material in the forms of theory, formulas, and graphics and then changed into an easily understood form

[8]. Conceptual understanding becomes a very important asset in solving certain problems because in solving existing problems it takes mastery of the concepts that underlie the problem [9], Conceptual understanding is also one of the keys to success in learning science, especially physics. The formula doesn't have to be memorized but rather to understand the concept [10]. To achieve conceptual understanding, 7 indicators must be mastered, namely interpreting, exemplifying, classifying, summarizing, concluding, comparing, and explaining. Conceptual understanding in physics is important because learning physics is a lesson that discusses the phenomena of nature, objects in the sky, and objects on earth [11]. Physics can explain various events taking place in the universe through explanation and calculations which aims to find regularity in human observation [12].

Based on pre-research data obtained by researchers at SMK N 7 Bandar Lampung, the average learning activity and conceptual understanding of the tenth-grade nursing students was still relatively less active and low. The students were not yet active in learning activities since they only listened to what was conveyed by the teacher. This might be caused by the learning process to be less interesting. Students tended to be passive [13] and less involved during the learning process [14]. Therefore we need a learning model in accordance with the situation, conditions, and needs of the students [15]. One model that is considered capable of answering these problems is the Advance Organizer learning model.

The advance organizer learning model is a way to obtain new knowledge associated with existing knowledge in previous learning. It means that each concept of knowledge has a certain concept structure that forms the framework of the information system that has been developed in science [16]. The advance Organizer model is designed to strengthen the students' cognitive structure. Ausubel states that a person's (cognitive knowledge structure) is the most important factor that orders whether new material will be more meaningful and how well it can be obtained and maintained [17]. The Advance Organizer model is designed to focus on how students process and relate new knowledge to prior knowledge. This will make the cognitive structure becomes better and will emerge the meaningful learning. Also, the advance organizer strengthens the students' cognitive structure or their knowledge of certain subjects and how to manage, clarify, and maintain such knowledge well [17]. Cognitive Domains are domains that cover the mental brain [18]. The Advance Organizer is a teaching tool that links new learning materials with initial knowledge [19] Initial knowledge underlines the main ideas in new learning situations and associates new ideas with existing knowledge [20].

Advance Organizer learning model has the advantage of being able to improve the students' thinking skills both individually or in groups [21]. Besides, students are also directed to construct the concepts that they want to achieve. Construction begins by giving a problem then students plan what will be done so that the problem can be solved by looking at the prerequisite material that they must master, namely what they know and what they don't know [22].

The main key to the success of the advance organizer learning model is that it is well organized so there is a good relationship between the main framework of the advance organizer model and the material presented [23]. In-depth emotional involvement between students and students and teachers will make the learning outcomes more meaningful [24].

Some studies that can improve learning activities are improving hydraulic system learning activities through jigsaw method [25], the application of JIGSAW cooperative learning model to Increase activity and learning outcomes [26], and several studies to improve conceptual understanding, namely the influence of direct learning model through Macromedia Flash-based animation towards students' interest and understanding of physics concepts [27]. and problem-based learning to improve math conceptual understanding in quadrilateral material [28].

This study presents a new focus which is different from the previously done studies. The difference lies in the use of the Advance Organizer learning model to determine its effectiveness in learning activities and students' conceptual understanding in physics learning.

2. Method

This research employed the quasi-experiment design. The experimental and control groups were not randomly selected. The design used in this study was Non-Equivalent Control Group Design (Setyosari 2015), because this study aims to determine the effectiveness of the Advance Organizer learning model that requires experimental and control classes as well as the pretest and posttest in both classes to find out the improvement of learning activities and students' conceptual understanding.

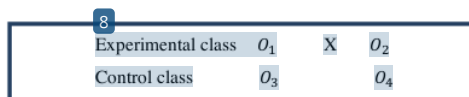


Figure 1. The Non-Equivalent Control Group Design

Notes:

X: Treatment

O1: Pretest in the experimental class

O2: Posttest in the experimental class

O3: Pretest in the control class

O4: Posttest in the control class

The sampling technique used in this study was purposive sampling because in taking samples, the researcher looked at specific objectives, for example, the limitation of time, energy, and fund so that large and distant samples cannot be chosen. Researchers used a purposive sampling technique due to considerations related to population characteristics and sample criteria needed in the study. These criteria include: students got the same physics learning material, students were supported by the same teachers, the books used by students were the same, the number of students of the two classes was the same.

The research instruments were a non-test instrument in the form of an observation questionnaire to measure students' learning activities and a test instrument in the form of a three-tier diagnostic test to measure the understanding of concepts. The test instrument was tested for its validity, discrimination index, level of difficulty, reliability, and item distractor.

Before the data were analyzed, the prerequisite tests were conducted in the form of normality tests using the Shapiro-Wilk test [29], homogeneity of variance test and homogeneity variance-covariance matrix test [30]. The analysis techniques used in this study: the hypotheses were the MANOVA test assisted by MSMSPPSS Statistics software 21, n-gain test, and effect size test. The N-gain test was done to see the extent of the ability to increase learning activities and students' conceptual understanding [31].

$$g = \frac{\% \text{ Posttest} - \% \text{ Pretest}}{100 - \text{skor pretest}}$$

The classification of gain value according to Hakke is as follows.

Gain Value	Interpretation
$g \geq 0,7$	High
$0,7 > 0,3 \geq g$	Medium
$g < 0,3$	Low

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Effect size measures the magnitude of the effect of a variable in the other variable. The variable which is often related is usually independent variables and dependent variables [32]. To test the effectiveness of the advance organizer model, the effect size equation can be used [5].

$$d = \frac{m_A - m_B}{\left[\frac{(sd_A^2 + sd_B^2)}{2} \right]^{1/2}}$$

Description:

d = effect size

m_A = average value of experimental class gain

m_B = average value of control class

sd_A = standard deviation of experimental class

sd_B = standard deviation of control class

Table 2. The Effect Size Criteria

Effect size	Category
d < 0.2	Low
0.2 ≤ d ≤ 0.8	Medium
d > 0.8	High

3. Results and Discussion

3.1 Results

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The results of pretest and posttest in the control and experimental classes are:

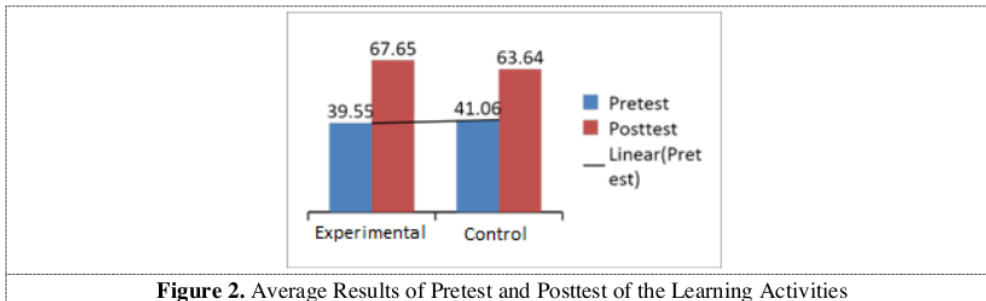


Figure 2. Average Results of Pretest and Posttest of the Learning Activities

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Figure 2 shows that the average score of the pretest in the experimental class is smaller than the control class while the average score of the posttest in the experimental class is greater than the control class.

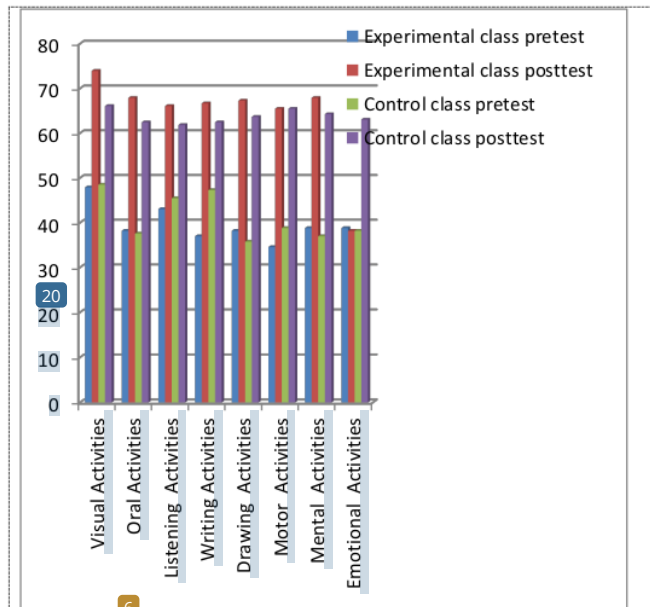


Figure 3. The Results of Pretest and Posttest based on the Types of Learning Activities

Figure 3 shows the experimental class's lowest aspect is motor activities and the control class's lowest aspect is drawing activities. The highest posttest aspect in the experimental class is visual activities (paying attention) and the highest posttest aspect in the control class is visual activities (paying attention).

The data was obtained from the results of non-test instruments in the form of observation questionnaires to determine learning activities and test instruments in the form of Three-Tier Diagnostic Test questions to determine students' conceptual understanding.

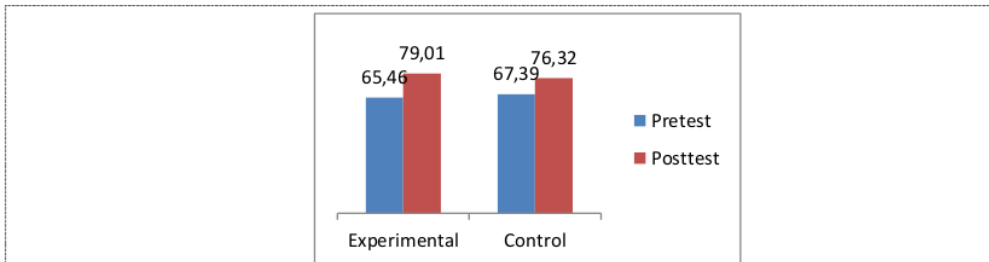


Figure 4. The Results of Average Pretest and Posttest of Conceptual understanding

Figure 4 shows that the average pretest score of the experimental class is smaller than the control class, whereas the average score of the posttest in the experimental class is greater than the control class.

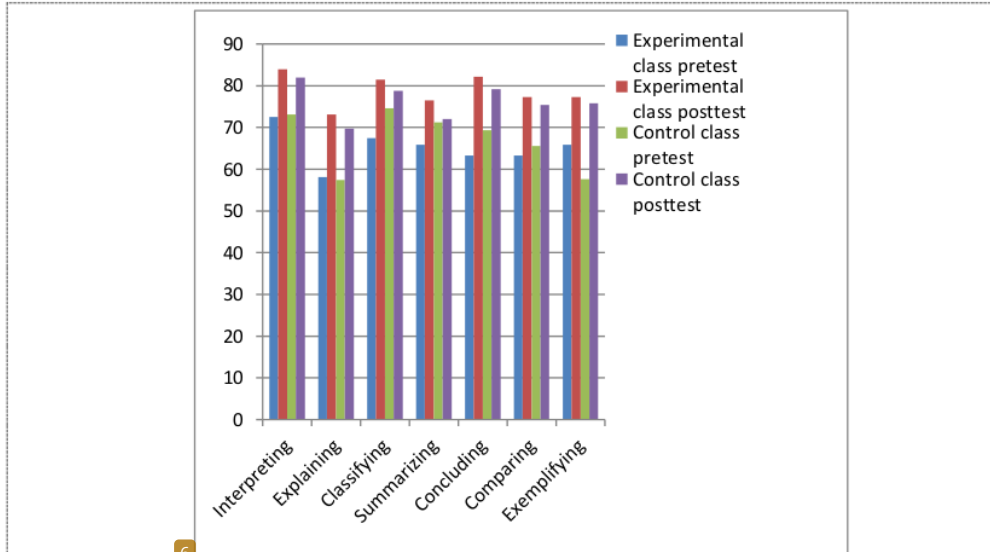


Figure 5. The Results of Pretest and Posttest Based on Conceptual understanding Indicators

Figure 5 shows the results of the concept of understanding the pretest in the experimental class. The lowest score obtained by both the experimental class and the control class is the explaining aspect and the highest score obtained by both experimental class and control class is the interpreting aspect.

Table 3. Normality Test of Posttest in the Experimental Class and Control Classes

Shapiro-Wilk Test	Learning Activities		Concept of Understanding		Result	Interpretation
	Experimental	Control	Experimental	Control		
<i>Sig.</i>	0,051	0,277	0,073	0,133	Sig> α	Normally Distributed
α	0,05	0,05	0,05	0,05		

The table shows that everything is normally distributed. The sig. value of learning activity for the experimental class is 0.051 while in the control class is 0.277, so it can be seen that the value of the experimental class is $0.051 > 0.05$ while in the control class is $0.277 > 0.05$. The sig. value of conceptual understanding for the experimental class is 0.073 while in the control class is 0.133, so it can be seen that the value of the experimental class is $0.073 > 0.05$ while the control class is $0.148 > 0.05$. This shows that all data are normally distributed.

Homogeneity test results can be seen in Table 9 as follows:

Table 4. Levene's Test of Equality of Error Variances

	F	df1	df2	Sig.
Learning Activities	,091	1	60	,764
Conceptual understanding	,068	1	60	,794

Based on table 9, The significant values of learning activities is $0.764 > 0.05$ and conceptual understanding is $0.794 > 0.05$. This shows that the variance is homogeneous. Besides that, based on the table above, we can find out that:

- Learning activity value of $F_{\text{observed}} = 0.091$ compared to $F_{\text{critical}} = 3.990924$, so $F_{\text{observed}} < F_{\text{critical}}$ ($0.091 < 3.990924$)
- Conceptual understanding value of $F_{\text{observed}} = 0.068$ compared to $F_{\text{critical}} = 3.990924$ so $F_{\text{observed}} < F_{\text{critical}}$ ($0.068 < 3.990924$)

Those conclusions show that the variance between data groups is homogeneous.

Homogeneity test of variance-covariance matrix used was Box's M

Table 5. Box's Test of Equality of Covariance Matrices

Box's M	,082
F	0,27
df1	3
df2	737280.000
Sig.	,994

Box's M value = 0.082 with a significant value of 0.994. According to the criteria, if the significant value is $> \alpha$ then H_0 is accepted because the value of $\text{sig} > \alpha$ where $\alpha = 0.05$. It can be concluded that H_0 is accepted where all 2 variables; Y (Learning Activity and Conceptual understanding) has the same variance-covariance matrix for variable X (Advance Organizer Learning Model).

Table 6. N-Gain Test Results of Learning Activities

Class	N	N-Gain	Category
Experimental	33	0.460351322	Moderate
Control	33	0.368108947	Medium

N-Gain value of experimental class' learning activities is 0.460351322, thus, it can be categorized as moderate and the N-gain value of the control class is 0.368108947 and can be categorized as moderate. This shows that learning activities in the experimental class and the control class have increased in the moderate category.

Table 7. The Effect Size Results of Learning Activities

The standard deviation of the Experimental class	The standard deviation of the Control class	Effect Size	Category
0.097	0.154	0.718	Medium

The effect size test shows the extent to which the Advance Organizer influences the learning activities. The standard deviation of the experimental class is 0.097 while the standard deviation of the control class is 0.154. The value of the effect size test for learning activities is 0.718 which is included in the medium category.

3.1.1 Conceptual understanding

Table 8. N-Gain Test Results of Conceptual understanding

Class	N	N-Gain	Category
Experimental	33	0.336668039	Medium
Control	33	0.217938993	Low

Based on this table, the N-Gain results of conceptual understanding of the experimental class are 0.336668039 and can be categorized as medium and the control class is 0.217938993 and can be categorized as low. This shows that the concept of understanding in the experimental class and the control class has increased in the medium category.

Table 9. The Effect Size Test Results of Conceptual understanding

The standard deviation of the Experimental class	The standard deviation of the Control class	Effect Size	Category
0.29	0.32	0.392	Medium

The results of the effect size test show the extent to which the Advance Organizer affects the concept of understanding. The standard deviation obtained by the experimental class is 0.29 whereas the standard deviation obtained by the control class is 0.32. The value of the effect size test is 0.392 which is included in the medium category.

3.1.2 Hypothesis Test

3.1.2.1 Multivariate Test

Table 10. The Results of Multivariate Test

	Effect	Sig
Treatment	Pillai's Trace	,000
	Wilks' Lambda	,000
	Hotelling's Trace	,000
	Roy's Largest Root	,000

Based on the table, the multivariate test of Pillai's trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root comparison test was successfully done.

Based on the results, the significant treatment value obtained using the Pillai's Trace, Wilks' Lambda, Hotelling's Trace, Roy's Largest Root respectively is 0.000 where 0,000 is smaller than 0.05, so it can be concluded that H_0 is rejected and H_1 is accepted. This means that the Advance Organizer learning model effectively enhances learning activities and conceptual understanding.

3.1.2.2 Between Subjects Effect Test

Table 11. The Results of Between Subjects Effects Test

Source	Dependent Variable	F	Sig.
Intercept	Learning Activities	8564.004	,000
	Conceptual understanding	10908.932	,000

Based on the table above, H_1 is accepted and H_0 is rejected occurs when a significance is $< \alpha$ then H_0 is not accepted and $F_{observed} > F_{critical}$. Based on the data obtained, the significant value of learning activities is 0.000 < 0.05 by comparing $F_{observed} = 8564.004$ compared to $F_{critical} = 3.990924$ with $df_1 = 1$ and $df_2 = 64$ ($8564.004 > 3.990924$) so that it can be concluded that H_0 is rejected and H_1 is accepted. The average variable Y_1 (learning activity) shows the difference in variable X (Treatment).

Based on the data, the conceptual understanding data is 0.00 < 0.05 then, compared to $F_{obs} = 10908.932$ compared to $F_{critical} = 3.990924$ with $df_1 = 1$ and $df_2 = 64$ ($10908.932 > 3.990924$) so it can be concluded that H_0 is rejected and H_1 is accepted. The average variable Y_2 (conceptual understanding) shows the difference in variable X (Treatment).

The table concludes that the Advance Organizer learning model is effective in increasing the learning activities and students' conceptual understanding with a significant level of less than 0.05.

3.2 Discussion

N-gain test results in the experimental class and the control class show that the learning activities and students' conceptual understanding have increased although, in the control class, the increase in learning activities and students' conceptual understanding is lower than that of the experimental class. Based on the results of the effect size test, the experimental class is more effective than the control class. This is because there are differences in the treatments given by the researchers to the students.

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The experimental class applied the advance organizer learning model and the control class applied the Problem-based Learning (PBL). The Advance Organizer learning model applied in the experimental class runs well because it is in line with the lesson plans.

4

The advantages of the Advance Organizer learning model are students can interact by solving problems to find concepts that are being developed, can improve academic material and social skills, can encourage students to know the answers to questions given (students are more active), can train students to improve their skills through group discussions, improve students' thinking skills both individually and in groups, and increase students' competence in class [21].

The advance organizer learning model has three steps. The first step is explaining the learning objectives. This initial step is to explain the learning objectives, present the learning objectives, identify the characteristics, provide examples, present the context, repeat the explanation [33]. In this step, the researcher explained the objectives to the students about what will be achieved in the learning process and then distributed worksheets to the students, made a connection to the previous material by providing examples that correlated them with the material about to be studied. The students paid attention and listened to the goals of the material in earnest. At this moment, there was an increase in visual activities (paying attention), emotional activities (enthusiasm), and listening activities. This is in line with research that states that the first step in teaching must focus on the attention and enthusiasm of students and students' concepts of understanding.

The next step is explaining the material and learning tasks. The teacher presented the material, aroused attention, and clarified the subject matter [33]. In this step, the researchers presented the subject matter and students paid attention and listened to the material in earnest. At this moment, there was an increase in visual activities (paying attention) and listening activities. This is in line with research which states that by paying attention and listening to the teacher's direction, the students will easily understand the material presented. Then, the researchers gave time for the students to ask what they were still confused about. At the presentation session, the students were given time to ask each other so they will better understand the material delivered. At this moment there was an increase in oral activities (asking). These results are in line with research that states that with the question and answer system, students will ask questions to better understand the material presented. When the researcher explained the temperature and heat material and wrote some formula on the board, the students immediately recorded the explanation and copy the formula written on the board. At this moment, there was an increase in writing activities and drawing activities. These results are in line with research which states that taking notes and drawing can be improved when wanting to easily understand the material through their writing. Then, the teachers provided questions for the students to work on. The students came to the front of the class to work on the questions. At this moment, there was an increase in mental activities (working on the questions). This is in line with research that states that if students dare to work on questions in front class, it means they are having good mental activities. Then, the teacher gave a group assignment to experiment with heat transfer guided by worksheets made by the teacher. The students did the experiment based on the worksheets. At this moment, there was an increase in motor activities (experiments). This is in line with research which states that by conducting experiments, it will be able to increase motor activities. Then, the teachers provided questions about the material and linked the questions to everyday life. The students became enthusiastic during the learning process. At this moment, there was an increase in emotional activities (spirit). This is in line with research which states that by giving some questions, the students become interested and more enthusiastic in learning and able to improve conceptual understanding.

The last step is strengthening cognitive organizing including the use of principles in an integrated manner, increasing the learning activities, and developing approaches to clarify learning materials [33]. In this step, the researchers emphasize the strengthening of the material by reviewing the material that has been delivered to students as well as giving questions about the material. The researcher also explained the use of concepts in daily life. At this step, the students focused on paying attention, asking questions, and listening to what was conveyed by the teacher. At this moment, there were increases in oral activities (asking), listening activities (listening), and visual activities (paying attention). These results are in line with research which states that when teachers reinforce the material by giving

questions, the students will be focused on listening, paying attention, asking [34], and also increasing students' conceptual understanding.

The relationship between learning activities and conceptual understanding is directly proportional, meaning that the higher the increase in learning activities, the higher the increase in conceptual understanding. This is because one of the behaviors to easily understand physics is the learning activities. With good learning activities, the students could be more focused to absorb materials delivered by the teacher since this activity supports the success of students [15].

This study is in line with other studies including; the Advance Organizer model can improve students' mathematical creative and critical thinking abilities [35], the effect of Advance Organizer-based project on students' analysis-synthesis skills, the Advance Organizer learning model with mind map can improve learning outcomes compared to the direct learning model [21], and the Advance organizer learning model influences the students' learning outcomes [8].

4. Conclusions and Suggestions

4.1 Conclusions

The Advance Organizer learning model is more effective in increasing the learning activities and students' conceptual understanding. It is indicated by the value of the effect size of learning activities of 0.718 and the value of conceptual understanding of 0.392 which are categorized as moderate. The value of learning activities and conceptual understanding is less than 0.05 (sig <0.05). So, it can be concluded that the Advance Organizer learning model is effective in learning activities and students' conceptual understanding in learning physics.

4.2 Suggestions

After paying attention to the research data as well as analysis and conclusions, the researchers suggest the other researchers to continue studying the Advance Organizer learning model on other physics materials. The researchers should first re-analyze the problems faced by students and adapt them accordingly, especially in terms of time allocation, learning support facilities, learning media, and students' characteristics.

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