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Application Of Colorado's Phet Assisted Argument Driven Inquiry Learning Model to Improve Understanding of the Concept of Dynamic Fluid Matter Class XI High School

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Abstract: The understanding of students' concepts in general can be said to be still at a stage that is not optimal. Generally, students are only focused on the material presented by the teacher without any effort to understand it well. This study aims to describe the understanding of students' concepts using the Colorado PhET-assisted Argument Driven Inquiry learning model on the dynamic Fluid material of class XI SMA second objective To find out the difference in understanding of student concepts between classes that use the *Colorado PhET-assisted Argument Driven Inquiry* learning model on the material dynamic fluid with classes that apply conventional learning in class XI of high school.. The research was conducted on students of class XI SMA Negeri 1 Kubu Babussalam on dynamic fluid material, the classes taken were class XI IPA B which amounted to 28 students and class XI Science A which amounted to 33 students where the two classes consisted of experimental classes and control classes. The data collection instrument is in the form of a test of the results of the postes understanding of concepts in dynamic fluid material class XI SMA which consists of 14 objective questions. The type of research is quasi-experiment with a *Posstest Only Non-equivalent Control Group Design*design. Independent sample t-test with the help of SPSS version 21 showed that the *Colorado PhET-assisted Argument Driven Inquiry* learning model affects students' understanding of concepts. The concept understanding ability of experimental class students is better than that of control class. Furthermore, the average score of the experimental class was 82.64 and the control class was 64.53. These results suggest that the *Colorado PhET-assisted Argument Driven Inquiry* learning model is effective against learners' conceptual understanding.

Keywords: Argument Driven Inquiry, PhET Colorado, Concept understanding, Dynamic fluids.

1. Introduction

Education plays an important role in improving the quality of human resources. Improving the quality of education is a process that is integrated with the process of improving human resources itself. Realizing the importance of the process of improving human resources, the government continues to strive to realize this mandate through the development and improvement of the quality of education [1]. [2] "Learning according to the theory of constructivism is a process of knowledge formation. This formation should be carried out by the learners themselves. Then the learner must actively carry out activities, actively think, compile concepts and give meaning to something he learns. So teachers, learning designers, and developers of these learning programs play a role in creating an environment that allows learning to occur.

The development of science literacy is necessary to help prospective teachers understand the content of science literacy and the elements of science literacy, and can use appropriate teaching methods as the main mechanism that will lead students to develop their science literacy through the learning process in the classroom. Based on the results of preliminary observations made in the science learning process that the achievement of competencies related to science literacy has not been as expected, so it is felt necessary to improve science literacy by using one of the learning models, namely the *Argument-Driven Enquiry* learning model [3].

Learning models that can be used in achieving learning objectives in accordance with the above exposure, one of which is the Argument-Driven Inquiry (ADI) model. This model is able to facilitate practicum activities. The ADI learning model provides an opportunity for learners to argue by presenting ideas and questions during investigations and drawing conclusions independently. The stages in the ADI model are 1) task identification, 2) data collection, 3) production of tentative arguments, 4) argumentation sessions, 5) preparation of investigation reports; 6) *peer review*, 7) report revision; 8) discussion [4].

The ADI learning model can train learners to improve their thinking by emphasizing the importance of an argumentation skill in improving and validating scientific knowledge [5] Learning using the ADI model will help students to learn to produce arguments that can provide explanations for research questions as partof the research process [6].

PhET simulations emphasize the relationship between real-life phenomena and underlying science, support interactive and constructivist approaches, provide feedback, and provide a creative workplace [7]. In physics lessons in some concepts there is a dynamic fluid concept that is suitable for PhET simulation media.

Based on interviews that have been conducted with physics subject teachers at SMA Negeri 1 Kububabussalam stated that students when discussing are less active in arguments and experiments are rarely carried out because of limited tools and time so that teachers prefer to deliver learning materials conventionally with the lecture and discussion method so that students only memorize concepts without understanding them. Experiments are rarely carried out because teachers think that experiments will consume a lot of time, which makes students' understanding of concepts low. One of the concepts that is considered difficult for students is dynamic fluid, because in this material there are many concepts that are abstract and related to phenomena that exist in everyday life, so it will be difficult to understand if the learning process is only by reading or explaining simply.

Dynamic fluids are matter related to everyday life. Based on the analysis of Basic Competencies 3.4 in class XI odd semester, "Applying the principle of dynamic fluids in technology", there is knowledge that is abstract so it is not appropriate if the material taught is only verbal or through image media only. Then it needs an interactive learning process so that learning does not tend to be boring. Dynamic fluid learning using the *Colorado PhET* program with the *Driven Argument Inquiry* model is expected to help students in the process of building understanding of students' concepts in learning, and make the learning process more interactive.

Based on the description above, it is necessary to apply *the Colorado PhET* media to improve students' understanding of the concept of physics lessons, namely the concept of dynamic fluids. then the author is interested in conducting a study with the title "Application of the *Colorado PhET-Assisted Argument Driven Inquiry* Learning Model To Improve Understanding of the Concept of Class XI High School Dynamic Fluid Matter"

2. Method

The research "Application of the *Colorado PhET-Assisted Argument Driven Inquiry* Learning Model to Improve Understanding of the Concept of Dynamic Fluid Matter Class XI SMA" was carried out at SMA Negeri 1 KubuBabussalam in the odd semester of the 2022/2023 Academic Year. This study was conducted in November 2022.

The method used in this study is an experimental method. The nature of this research uses a quasi-experimental design (pseudo-experiment) with the research design used is the *Posttest Only Non-equivalent Control Group Design*, namely there are two groups, the experimental class, namely the class given *treatment* and the control class, namely the class without *treatment* [8]. The design pattern *of Nonequivalent Control Group Design* research can be described as follows [9]:

Table 3.1 Research design

Class	Treatment	*Posttest*
Experimental Class	X	O1
Control Class		O2

In the treatment class, learning was given using the *Argument Driven Inquiry* learning model assisted by*PhET Colorado* (X). For the control class itself uses active lecture methods and conventional media during the learning. After the learning was carried out in both groups, students were given a final test /*posttest* to find out the improvement of students' understanding of concepts in the dynamic fluid material of SMA N 1 KubuBabussalam.

The population in this study was all students of class XI SMA Negeri 1 KubuBabussalam for the 2021/2022 school year, totaling 90 students. A breakdown of the population numbers can be seen in Table 3.2.

Table 3.2 Population of students of class XI SMA Negeri 1 KubuBabussalam

Class	Number of Learners
XI A	33 People
XI B	28 People
XI C	29 People
Total	90 People

(Source: Sma N 1 Kubu Babussalam Data)

The samples in this study were carried out with normality tests and homogeneity tests of the previous material test values which were prerequisites before the research was carried out.

The sample from this study used 2 classes taken by *random sampling* , namely by drawing lots for one experimental class and one control class.

The data collection technique in this study is a test technique in the form of *a posttest* given in the experimental class and control class. Posttest giving *to* students is carried out after the learning process. The questions given in the experimental class and the control class are the same, then the students' answers are analyzed by calculating the number of student scores with the total number of scores.

The data analysis techniques used in this study are descriptive analysis techniques and inferential analysis.

Descriptive analysis is an analytical technique that only presents information in the form of observed data and does not aim to test hypotheses to draw conclusions. That's why descriptive analysis including deductive statistics karena does not draw conclusions. The descriptive analysis referred to in this study looked at the understanding of the concept of students consisting of the absorption of students. [10]: Learner absorption is the ability of learners to absorb a concept or material that has been delivered by the teacher. Systematically to find the absorption of learners used provisions such as the following equation.

$$Daya\ serap = \frac{skor\ yang\ diperoleh\ siswa}{skor\ maksimum} \times 100\%$$

Inferential statistical analysis technique, which is to test success with learning outcomes before and learner learning outcomes after action using hypothesis tests or t tests. However, the use of the "t" test must meet two conditions, namely the homogeneity and normality test.

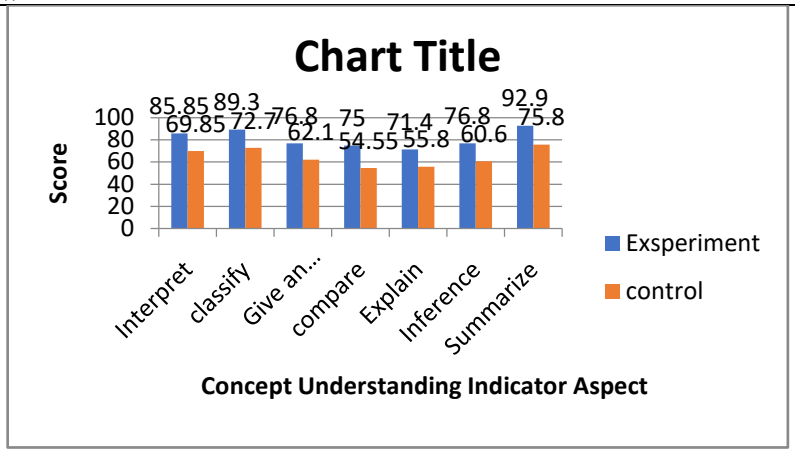
3. Results and discussion

The data analyzed in this study are data on students' understanding of concepts in experimental classes and control classes on dynamic fluid materials. Data on students' understanding of concepts was obtained from the results of the *posttest* conducted after using the Argument Driven Inquiry learning model assisted by *PhET Colorado* in class XI IPA B as an experimental class and conventional learning in class XI IPA A as a control class in SMA Negeri 1 KubuBabussalam. student absorption of dynamic fluid materials through an *Argument Driven Inquiry-assisted* learning model *Colorado PhET* in the experimental class and conventional learning in the control class is shown in Table 4.1.

No.	Interval	Category	Experimental Class		Control Class	
			Percentage (%)	Sum Student	Percentage (%)	Sum Student
1.	85 ≤ x ≤100	Excellent	53,57	15	12,12	4
2.	70 ≤ x < 85	Good	39,28	11	24,24	8
3.	50 ≤ x < 70	Good Enough	7,14	2	63,63	21
4.	0 ≤ x < 50	Not Good Enough	0	0	0	0
Average			82,64		64,53	
Category			Good		Good Enough	

Based on Table 4.1, it can be seen that the average absorption rate of students in experimental classes using the *Colorado PhET-assisted Argument Driven Inquiry* learning model is higher than that of control classes using conventional learning. This was shown in the experimental class, the average absorption rate of students reached 82.64% and the control class was 64.53%. The percentage category of absorption of the average absorption of experimental class students is good while the control class category is quite good.

After obtaining posttest results in experimental classes using the *Argument Driven Inquiry* learning model assisted by*PhET Colorado* and control classes with conventional learning, from the posttest result data,analysis was carried out using SPSS. Inferential analysis in this study includes normality test, homogeneity test, and hypothesis test (t test). Before conducting a hypothesis test, a prerequisite test is first carried out, namely the normality test and the homogeneity test of the concept comprehension test data of the experimental class students and the control class on dynamic fluid materials.



Concept understanding Figure 4.1 can be seen that the understanding of experimental class concepts using the *Colorado PhET-assisted Argument Driven Inquiry* learning model is higher in each indicator compared to control classes using conventional learning. In line with the results of the study [11] states that the *Argument Driven Inquiry* learning model can improve students' understanding of concepts, it can be seen from the results of data analysis that there is an improvement in each learning cycle.

To better know the understanding of students' concepts, an analysis of concept understanding indicators is carried out which includes indicators of explaining, summarizing, interpreting, classifying, attracting inference, comparing, and exemplifying. Analysis of indicators in the experimental class showed that of the seven indicators of concept understanding, the summarizing indicator was the indicator with the highest percentage, namely with a percentage of 92.9%. While the indicator explains that it is the indicator with the lowest percentage with a percentage gain of 71.4%. In the control class itself, an analysis of indicators of understanding concepts is also carried out which includes indicators of explaining, summarizing, interpreting, classifying, attracting inference, comparing, and exemplifying. The summarizing indicator is also the indicator with the highest percentage in the control class, namely with a percentage of 75.8%. While the comparing indicator is the indicator with the lowest percentage with a percentage gain of 54.55%. From the results of data analysis, the understanding of the concept of each indicator in the experimental class and the control class there are differences. Based on the graph in Figure 4.1, it can be seen that each concept understanding indicator between the *concept understanding posttest* scores in each class has differences.

In the previous inferential data analysis, researchers conducted prerequisite tests, namely data normality tests and data homogeneity tests to be able to conduct hypothesis tests, after being tested, it was found that both classes had signification values greater than 0.05, meaning that both classes were said to be homogeneous and normally distributed. Because both classes have the same variation and are normally distributed, hypothesis testing can be carried out using *an independent sample t-test* conducted with the SPSS 21 program. The hypothesis in this study obtained by using the *independent samples t-test* obtained a significance value (2-tailed) of 0.000 which means that there is a significant difference in students' understanding of concepts between classes that use the *Colorado PhET-assisted Argument Driven Inquiry* learning model and classes that apply conventional learning to dynamic fluid materials.

4. Conclusions And Recommendations

Based on research that has been conducted at KubuBabussalam State High School 1 by applying the Colorado PhET-assisted Argument Driven Inquiry learning model, students' understanding of the concept of dynamic fluid materials was obtained in an experimental class that applies the *Colorado* PhET-assisted Argument Driven Inquiry learning model higher than in control classes that apply conventional learning models. This is evident from the higher average absorption value of the experiment class than the control class where in the experimental class the average absorption value of the students is in the good category while the average absorption value of the students in the control class is in the fairly good category. In interference, there are significant differences in students' understanding of concepts between classes that apply the *Colorado PhET-assisted Argument Driven Inquiry* learning model and classes that apply conventional learning models with a higher understanding of concepts in the experiment class than the control class. Therefore, learning that applies the *Colorado PhET-assistedArgument Driven Inquiry* model can be able to improve students' understanding of concepts in dynamic fluid materials in class XI of State High School 1.

Based on the conclusions that have been presented, there is something that the author can propose,

namely the use of the *Argument Driven Inquiry* learning model assisted by*PhET Colorado* can be used as an alternative that can be applied in the learning process in schools. In addition, it is also recommended to carry out the same research on different subject matter at different levels of education in order to improve the quality of education in the future. Especially for materials that contain elements of research.

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