ATLANTIS PRESS
Advances in Social Science, Education and Humanities Research (ASSEHR), volume 208
1st International Conference on Social Sciences and Interdisciplinary Studies (ICSSIS 2018)

The Effect of Argument Driven Inquiry Model Using Virtual Laboratory to Increase the Scientific Argumentation Ability of Primary School Teacher Education Program Students

1st Imelda Free Unita Manurung
Department of Primary School Teacher Education, Faculty of Education
Universitas Negeri Medan
Indonesia
imeldafreeunitamanurung@gmail.com

2nd Elvi Mailani
Department of Primary School Teacher Education, Faculty of Education
Universitas Negeri Medan
Indonesia

3rd Akden Simanihuruk
Department of Primary School Teacher Education, Faculty of Education
Universitas Negeri Medan
Indonesia

***Abstract*-The purpose of this study was to determine the differences between scientific argumentation ability for students who learned the basic concepts of science by using the argument driven inquiry model with virtual laboratory and argument drivent inquiry model without virtual laboratory. The study was conducted using a quasi-experimental method with a randomized control group pretest-posttest design. The population were all Primary School Teacher Education Program students at state University Of Medan. There were two sample that chosen at random cluster sampling. The results showed that normalized gain average score for scientific argumentation ability in the experimental class was 0.65 which met the criteria of being, and in the control class was 0.37 which met the criteria of being. Based on the average difference test, the results showed that the argument driven inquiry model with virtual laboratory significantly increased the scientific argumentation of Primary School Teacher Education Program students compared to argument driven inquiry model without the virtual laboratory.**

Keywords-argument driven inquiry, virtual laboratory, scientific argumentation ability

I. INTRODUCTION

The development of science and technology has resulted in learning paradigm shift, so that the current lecture is no longer just focusing on lectures but rather focusing on students. Students actively take part in the lecture process especially in science courses through a practicum program. However, the implementation process has not been implemented optimally. Based on the preliminary study conducted by researchers at one of the primary school teacher education program, there were inadequate rooms and practical equipment, so that the science course practicum had not been maximized. Cognitive abilities that are seen from the results of student's final grades indicate the low ability of students in science courses. Students inactivity in the leearning process is felt to be one of the causes of low cognitive abilities of students.

Students lack confidence in submitting opionions about science materials that they do not understand so the students argumentation ability are low [1]. For this reason, researchers want to implement the argument driven inquiry model learning to try to change the learning patterns of students to improve student's ability to argue. This research is supported by previous research which states that the argument driven inquiry model can improve the argument driven inquiry [2]. Changing in mindset in the field of science must be accompanied by activeness in the lecture process, namely through practical activities.

The limitations of the room and practicum equipment are felt not to be an obstacle in conducting the practicum process. So the researchers tried to apply the argument driven inquiry learning model using a virtual laboratory in practicum. The stages of argument driven inquiry learning model [3] are as follows : (1) identification of tasks and inquiry questions, (2) data collection and data analysis, (3) development of tentative arguments that contain explanations, proofs, and reasoning using a medium that can be shared. This step can help the lecturer see student thinking (ideas, evidence, reasoning), (4) carry out additional data collection by means of literature studies or experiments, (5) preparation of reports based on facts obtained from results of literature studies and experiments, (6) evaluation of reports and reflections from lecturers to avoid misconceptions.

Virtual laboratory is computer software designed so that someone can carry out experimental activities as well as conducting experiments in real laboratories. Virtual laboratory also have a series of laboratory instruments in the form of interactive multimedia based computer software, which are computer operated and can simulate activities in the laboratory as if the user is in a laboratory where virtual laboratory are systems that can be used to support lab systems that can be used to support lab systems that can be used to support lab systems which runs conventionally, so the use of this virtual laboratory can provide opportunities for students to do lab work through computer media and experiments can be done anywhere, provided there is a computer device. This is expected to be effective learning because in addition to being able to do it in lecturers, experimental activities can be carried out independently by students.

In this study the virtual laboratory used was designed using macromedia flash 3 [4]. Virtual laboratory use can improve student's cognitive ability [5], so that this study tries to use a virtual laboratory to improve scientific literacy ability and argumentation ability. Arguments

resemble an organism that has individual parts with different functions related to claims. Toulmin revealed the elements for analyzing an argument, namely: (a) claims, (b) evidence, (c) warrant, (d) backing, (e) rebuttal [6]. Besides being able to develop the ability to argue, argument driven inquiry model can also improve the scientific literacy ability. Science literacy according to PISA [7] is defined as "the capacity to use scientific knowledge, to identify evidance based questions and conclutions in order to help make the natural world and the changes made to it. Through human activity". Science literacy is defined as ability to use scientific knowledge, identify questions, and draw conclutions based on existing evidence, so that they can understand and make decisions related to nature and changes made to natures through human activities. Science literacy become widespread attention for scientists, lecturers, and public holders now [8]

II. Material and Method

The method used was the quasi experimental method and the experimental design used was the randomized pretest-posttest control group design [9]. The experiment was carried out by giving a virtual laboratory assisted argument driven inquiry model to the experimental group and the argument driven inquiry learning model in the control group. The test instrument used to measure the ability to argue scientifically is in the form of description with an assessment rubric and to measure the ability of scientific literacy in the form of multiple choices. Before the test is given it is necessary to do as validity, a measure that shows the level of validity or validity instrument [10]. An instrumen said to be vakid if it ts able to measure what is desired and can reveal data from variables that are properly examined [11]. Furthermore, reliability needs to be done is the level consistency (test), which is to determine which ones can be trusted to produce (consistent) values tested on different calls [11]. The following equation is used to determine the reliability value of the test instrument [11]

$$r_{xy} = \frac{n\sum X_i Y_i - \left(\sum X_i\right)\left(\sum Y_i\right)}{\sqrt{\left\{n\sum X_i^2 - \left(\sum X_i\right)^2\right\}\left\{n\sum Y_i^2 - \left(\sum Y_i\right)^2\right\}}}$$

(1)

Then it is necessary to do a level of ease test that shows the difficulty and ease of the question calculate using equations [11]

$$P =$$

(2)

Distinguishing power is the ability of a problem to distinguish between high ability students and low ability students. To determine the value of distinguishing power, the following formula is used [11]

$$DP = \frac{B_A - B_B}{J}$$

(3)

After conducting an instrumen trial, data processing was carried out by calculating the average score of pretes, posttest, gain, and N-Gain in the control and experiment classes, hypothesis data use by uji-t. If data distribution normal and homogen, hypotesis calculated using parametric statistic tests. Decision making is if the value is sig. < α, with α = 0,050 then H_A is accepted.

III. Result and Discussion

Research on the argument driven inquiry model assisted by a virtual laboratory to improve the ability of scientific argumentation was carried out in three stages. Before learning, the preteset is carried out. The pretest is done to measure the ability of scientific argumentation before students get treatment. After pretest, during the three stages the learning was carried out by applying the argument driven inquiry learning model assisted by virtual laboratory in the experimental class, and the argument driven inquiry learning model assisted by virtual laboratory assistance in the control class. After three stages ended, then the final test (posttest) was carried out to determine the ability of students scientific argumentation after being given treatment. The material taught is straight motion kinematics which consists of several learning topics, namely distance and displacement, regular stright motion, and straight motion changes irregularly. Virtual laboratory used is made through the macromedia flash 3 program. See figure 1 below.

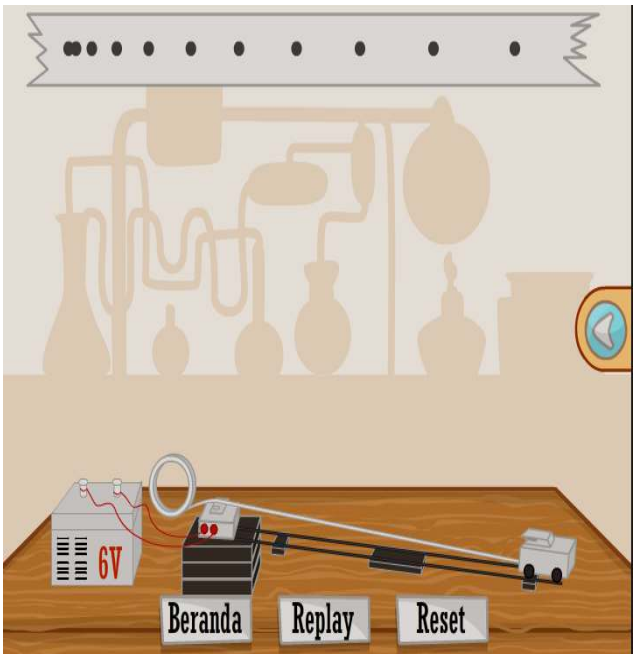

Fig 1. Virtual laboratory

The ability to argue students in the experimental class and the control class was measured by an eight-item description test using the assessment rubric. The questions made refer to indicators of argumentation skills for straight motion kinematics teaching material. This test is done twice, namely before treatment (pretest) and after treatment (posttest). The normalized pretest, posttest, and gain scores <g> argumentation sbility obtained by students in the experimental class and control class are listed in Table 1

TABLE I. RECAPITULATION OF AVERAGE SCALE PRETEST, POSTTEST, AND <G> ARGUMENTATION ABILITY OF EXPERIMENT AND CONTROL CLASS STUDENTS

Class	Test	Xmin	Xmax	$\bar{X}$	G	<g>
Experiment	Pretest	0,00	0,34	0,02	0,77	0,78
	Posttest	0,66	0,90	0,79		
	Improvement Criteria			High		
Control	Pretest	0,080	0,14	0,11	0,60	0,67
	Posttest	0,58	0,82	0,71		
	Improvement Criteria			Middle		

Based on Table. 1, it can be seen that students ability to argue for the experimental class and the control class has increased. The increase can be seen from the average score of the pretest and posttest in the experimental class and the control class. However, the magnitude of the increase in the two classes is different. For more details, the following is a comparison diagram of the average score of the prestest, posttest and <g> ability to argue students between the experimental class and the control class getting from N-Gain formula [11].

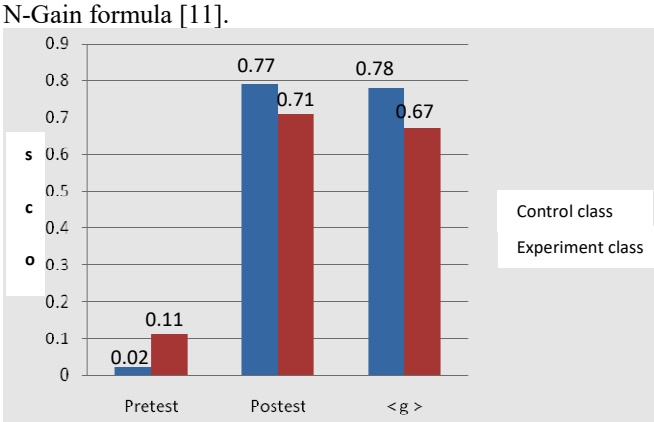

Fig. 2. Scores of Pretest Average, Posttest, and <g> Ability to Argue for Students in Experimental Classes and Control Classes

Based on the diagram in Fig. 2, there is clearly a difference in the increase in argumentation ability bertween the experimental class and the control class. The average score in the experimental class is 0,020 and thes students in the control class are 0,11. While the average score of the posttest obtained by students in the experimental class was 0.79 and the students in the control class wew 0,71. Obtaining a normalized gain average score <g> argumentation ability for the experimental class and the control class amounted to 0,78 and 0,67, respectively.

The average gain score of the normalized argumentation ability <g> in the control class includes the moderate criteria and the acquisition of average score of the gain of normalized argumentation ability <g> in the experimental class is included in the high criteria. Thus, the average increase in the ablity to argue the experimental class is quantitatively greater than the control class. To find out whether the difference in the average score increase in argumentation ability is significant or not, then the test of significance of the average difference (hypothesis test) is conducted. The analysis was carried out by testing the normality and homogenity of the data distribution gains normalized argumentation ability (N-gain) obtained by each student from the experimental class and the control class. Then proceed with the test of the significance of the average difference.

The normality and homogenity tests were carried out on the difference in posttest scores and pretest ability to argue with normalized students (normalized gain) in the experimental class and the control class. This test is carried out using the help of IBM SPSS Statistics 18 data processing software. The following is a recapitulation table of the results of the normality and homogenity test for normalized gain score for the experimental class and the control class.

TABLE II. RECAPITULATION OF THE RESULTS OF NORMALITY AND HOMOGENITY DATA TEST INCREASING ARGUMENTATION ABILITY OF EXPERIMENT AND CONTROL CLASS STUDENTS

<g>	N (total)	Normality Test		Homogenity Test	
		Sig.	Interpretation	*Sig.*	Interpretation
Experiment	34	0,20	Normal Data Distribution	0,31	Varians Data Homogen
Control	34	0,15	Normal Data Distribution		

In the Table. 2 , it can be seen that based on the normality test for the number of samples 34 and the confidence level of 95% for experimental class in the data distribution <g> the ability to argue obtained significance of 0,20 (sig. <0,050). In the control class with the number of samples 34 and the confidence level of 95% in the data distribution <g> the ability to argue obtained siginificance of 0,15 (sig.>0,050). Based on these results, it can be concluded that the data <g> the ability to argue in the experimental class and the control class are normally distributed. In addition to the normality test data, in Table.2, the results of homogenity test using Levene Test (test of homogenity of Variences) are obtained, the significance value of the data <g> argumentation ability is 0,31 (sig>0,050). The significance value of the data obtained is greater than the significance level of 0,050 so that it can be concluded that the variance of the two groups of data is homogeneous. The results of hypothesis testing obtained a significance level of 0,00. This significance level shows a value that is smaller than 0,050, which means that at the level of confidence 95% the application of the argument driven inquiry learning model with a virtual laboratory assisted inquiry can significantly improve students ability to argue in the matter of staight motion kinematics compared to the application of the driven inqury argument model without virtual laboratory (H_o rejected and H_A accepted).

The ability to argue in this study refers to the indicators of the ability to argue formulated by Toulmin which includes the submission of claims, fata, warrant, backing, and rebuttal. The following is a table of mean scores for pretest, posttest, and <g> for each indicator of argumentation ability in the experimental class and the control class.

TABLE III. RECAPITULATION OF AVERAGE SCALE PRETEST, POSTTEST, AND <G> ARGUMENTATION ABILITY OF EXPERIMENTAL AND CONTROL CLASS STUDENTS AT EVERY INDICATOR

Argumentation Ability Indicator	Experiment			Control		
	Pretest	*Posttest*	*<g>*	*Pretest*	*Posttest*	*<g>*
Claim	0,055	0,88	0,87	0,077	0,60	0,69
Data	0,059	0,84	0,83	0,32	0,68	0,71
Warrant	0,010	0,73	0,73	0,00	0,55	0,65
Backing	0,0020	0,72	0,72	0,00	0,49	0,59
Rebbutal	0,017	0,79	0,78	0,091	0,73	0,70

The following is a diagram of the normalized gain average score <g> on each indicator of argumentation ability between the experimental class and the control class obtained based on the data in Table 3.

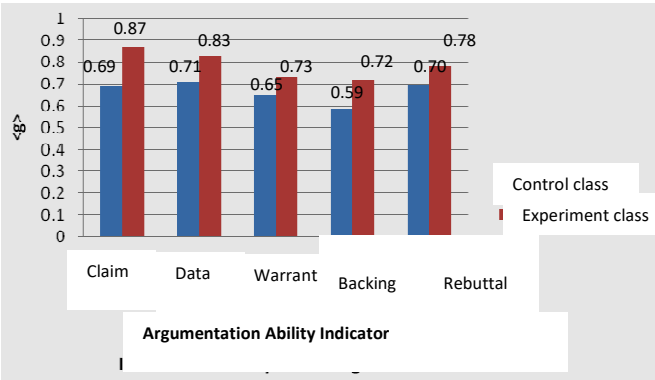

Fig. 3. Scores of Pretest Average, Posttest, and <g> Ability to Argue Student Experiment Class and Control Class on Each Indicator

The diagram in figure 3 above shows an increase in students ability to argue in a straight motion kinematics teaching material for each indicator. Based on the diagram, it is known that the increase in the argumentation ability for each indicator in the experimental class in higher than the increase in the argumentation ability for each indicator in the control class. An increase in the claim filling indicator in the experimental class is 0,87 while the control class is 0,69. The increase in the data submission indicator in the experimental class is 0,83 while the control class is 0,71. The increase in the indicator of justifying the experimental class is 0,73. While the control class is 0,72 while in the control class is 0,59. The increase in the refutation indicator in the experimental class is 0,78 while the control class is 0,70.

Based on these results, the increase in the ablity to argue students for each indicator in the experimental class in higher than the control class. This is caused by the application of the driven inquiry argument model assisted by virtual simulations in the experimental class, while in the control class applying the argumen driven inquiry learning model without the help of virtual laboratory. However, even in the control class there was an increase in each indicator of the ability to argue. The higher increase in the experimental class is because the learning steps in the experimental class besides being more enjoyable, also make it easier for students to form concepts so that they can help students make the right argument. These results are in accordance with the findings based on the questionnaire filled out by students, namely 100% of students felt happy with the learning activities carried out and 82% of students stated that the teaching and learning activities carried out made it easier for students to make scientific arguments. In the experimental class, the making of arguments begins with conducting experiments. Though trial activities, students answer the problems given. The main objective of the experiment is to equip students with the concepts used as a basis for students to argue. Furthermore, the ability to argue is trained through the stages of making tentative arguments, the stage of presenting arguments, and the stage of correcting arguments.

IV. CONCLUSION

Based on the results of the research and data analysis regarding the application of the argument driven inquiry learning model with virtual laboratory, it was concluded that the application of the argument driven inquiry learning model wit virtual laboratory assisted inquiry could significantly improve student argumentation skills compared to the argument driven inquiry learning model without virtual laboratory.

REFERENCES

[1] R. M. Probosari, M. Ramli, Harlita, M. Indrowati, and Sajidan, "Profil Keterampilan Argumentasi Ilmiah Mahasiswa Pendidikan Biologi FKIP UNS pada Mata Kuliah Anatomi Tumbuhan," *Bioedukasi*, vol. 9, no. 1, pp. 29–33, 2016.

[2] A. M. K. Putri, "Pengaruh Model Pembelajaran Argument Driven Inquiry (ADI) Terhadap Kemampuan Literasi Sains Peserta Didik," 2017.

[3] Siswanto, I. Kaniawati, and A. Suhandi, "Penerapan Model Pembelajaran Pembangkit Argumen Menggunakan Metode Saintifik untuk Meningkatkan Kemampuan Kognitif dan Keteramplan Berargumentasi Ilmiah," *J. Pendidik. Fis. Indones.*, vol. 10, no. 2, pp. 104–116, 2014.

[4] Macromedia, "Macromedia Flash," *Computer (Long. Beach. Calif).*, vol. 3, no. 1, pp. 9–16, 2007.

[5] H. Hermansyah, G. Gunawan, and L. Herayanti, "Pengaruh Penggunaan Laboratorium Virtual Terhadap Penguasaan Konsep dan Kemampuan Berpikir Kreatif Siswa pada Materi Getaran dan Gelombang," *J. Pendidik. Fis. dan Teknol.*, vol. 1, no. 2, p. 97, 2017.

[6] S. E. Toulmin, *The uses of argument: Updated edition*. 2003.

[7] PISA, "PISA 2015 Draft Science Framework," *Oecd*, no. March 2013, p. 52, 2013.

[8] C. Impey, "Science literacy of undergraduates in the united states," *Organ. People Strateg. Astonomy 2 (OPSA 2)*, vol. 2, no. Opsa 2, pp. 353–364, 2013.

[9] J. R. Fraenkel, N. E. Wallen, and H. H. Hyun, *How to Design and Evaluate Research in Education*. 2012.

[10] S. Arikunto, "Prosedur Penelitian Suatu Pendekatan Praktik," in *Jakarta,PT Rineka Cipta*, 2007.

[11] Sugiyono, "Metode Penelitian Pendidikan Pendekatan Kuantitaif, Kualitatif, dan R&D," *Metode Penelitian Pendidikan Pendekatan Kuantitaif, Kualitatif, dan R&D*. 2013.