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SOPHISTICATED THINKING BLENDED LABORATORY (STB-LAB) LEARNING MODEL: IMPLICATIONS ON VIRTUAL AND REAL LABORATORIES FOR INCREASING UNDERGRADUATE STUDENT'S ARGUMENTATION SKILLS

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ABSTRACT

Laboratory activities require scientific processes. The crucial scientific process in laboratory activities is aligning with 21st Century skills. Argumentation skills in laboratory activities are needed to make laboratory activities run efficiently, effectively, and without misinformation. Sophisticated Thinking Blended Laboratory (STB-LAB) in laboratory activities is considered capable of improving argumentation skills because of its syntax, disposition, and argumentation stage, allowing students to train their argumentation skills. This study intends to determine whether the STB-LAB learning model can improve students' argumentation skills in virtual and real laboratory activities. The method uses quantitative research with a one-group pretest-posttest design in which the N-Gain will be generated from the pretest and posttest, and find the difference in pretest and posttest, t-test using independent sample t-test, and effect size using Cohen's D. The results show that N-Gain obtained in virtual laboratory activities, only two aspects were categorized as quite effective, namely warrant, and backing aspects. In addition, N-Gain obtained in real laboratory activities only has three aspects categorized as quite effective: evidence, warrant, and rebuttal. The hypothesis obtained in both laboratory activities is 0.000 at Sig. (2-tailed), and the Effect Size obtained in both laboratory activities is 0.91 and 0.79. Thus, STB-LAB can improve argumentation skills using two media, with the virtual laboratory getting the highest results in its improvement. This shows that STB-LAB is appropriate for improving argumentation skills at the undergraduate level.

Keywords: argumentation skills; real laboratory; sophisticated thinking blended laboratory; STB-LAB; virtual laboratory

INTRODUCTION

Laboratory activity applies experiments intending to find the truth and/or verify a theory (Listiawati et al., 2022). Laboratory activities in learning should include the ability to improve students. The abilities that are loaded to be improved for students believe in 21st-century skills, especially essential 21st-century cognitive skills, including argumentation skills (Miaturrohmah & Fadly, 2020).

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The skill to argue is a skill where someone can think about something before acting. In general, argumentation skill has two main components, namely; (1) the skill to construct arguments; and (2) the skill to implement the results of argument construction (Clark et al., 2010). In particular, argumentation skill is divided into five aspects, namely; (1) Claims; (2) Evidence; (3) Warrants; (4) Backing; and (5) Rebuttal. Each aspect of argumentation skills has its own explanation. Claim is the provision of a statement or opinion in solving an existing problem. Evidence is an explanation or provision of evidence to support the opinion that has been presented in a claim. Warrant is an analysis of the relationship between opinion and evidence. Backing is a basic explanation of the theory or facts that support an opinion. Rebuttal is a statement made from claims to warrants (Noroozi et al., 2020).

Argumentation skill is essential to be possessed by a person or student because this argumentative skill will build the foundation of 4C skills, as well as scientific literacy needed for 21st-century skills (Noviyanti et al., 2019). The 4C skills, as well as scientific literacy, definitely require a connection between previous knowledge and new information, with efforts to connect these two factors, which can produce students' argumentation skills (Bertling et al., 2015).

Argumentation skills are essential when conducting laboratory activities because laboratory activities require constructing a theory in which the construction theory will answer how students answer a question through experimentation. The construction of a theory to answer questions that arise is very necessary for qualified argumentation skills because when arguing, students are required to make judgments in making decisions, and argumentation skills are also included in critical thinking skills (Erika & Rahmadani, 2021). As previous researchers have done research, in laboratory activities, students must have qualified arguments before students can carry out experiments (Setya et al., 2021). In addition, Higher Order Thinking Skills (HOTS) will only be fulfilled if students possess argumentation skills (Tobing et al., 2022). Therefore, science learning activities that use laboratories in the process must accommodate argumentation skills to support 21st-century learning (Perdana et al., 2019).

Based on a preliminary study conducted by researchers at one of the colleges in the city of Bandung, with twenty undergraduate students from the physics education department as subjects, the results showed that the ability to argue was low, as shown in the results of the five aspects used believed; (1) Claims; (2) Evidence; (3) Warrants; (4) Backings; and (5) Rebuttal, that on average 75% of students get low results, 15% of students get medium results, and 10% of students get high results. The results of the argumentation skill test were continued by interviewing each subject with the average result that the subject felt that they were not trained in arguing when carrying out laboratory activities, even the subjects only felt they were more focused on finding data and making research reports only. As many as 40% of the subjects stated that they had just discovered the ability to reason in laboratory activities because they only carried out a cookbook and inquiry-based laboratory activities. In addition, as many as 60% of the subjects did not feel the essence of laboratory activities. They stated they were not given space to express opinions or ideas because the laboratory activity model only refers to predetermined steps, and there is no feedback from the assessor on the results of their findings. Ismet (2017), in his research, revealed the findings at the Faculty of Teacher Training and Education, Sriwijaya University descriptively, that the students' reasoning abilities were still low. In addition, one of the studies conducted by other researchers at one of the universities in Bandung found that the argumentation skill is relatively low to medium, with scores in the range of 0.8 to 1.9. (Suhandi, 2012)

Overall, the preliminary study conducted by the researcher showed that the students' argumentation skills were low due to the laboratory activity model, which did not give freedom of expression to argue their findings. Research conducted by previous studies stated that the cookbook laboratory activities only contained directions that were directly carried out by students, so students only verified findings without any arguments from previous students (Fadaei, 2021). Students who use the old laboratory activity model tend to be less familiar with 21st-century skills because the syntax does not refer to 21st-century skills. This is also included in the ability to argue (Malik et al., 2018). In addition, previous research explains that students tend to have less honed their argumentation skills when students are limited in their opinions, such as when using laboratory activities that do not facilitate argumentation (Katchevich et al., 2013). The need for guiding students in arguing can teach students how to argue; as reported in previous research, students tend not to know how to argue according to their essence, but when given the ability to argue, students tend to make arguments according to their essence. This can be trained using appropriate laboratory activities because they can make students skilled in formulating hypotheses to defend arguments based on their findings (Walker & Sampson, 2013).

Argumentation skills are essential in the 21st century that focus on learning outcomes. In curriculum, argumentation skills are essential because the curriculum includes the goal of students being able to solve a problem following the knowledge group being studied (Ramadoan et al., 2019). In addition, argumentation skills are beneficial in real life because in solving problems, there must be an initial argument to provide a basis for problem-solving. Argumentation skills can make logical conclusions when there are differences of opinion in problem-solving (Antonio & Prudente, 2021). Argumentation skill does not only apply in the realm of science but also the social, economic, and political realms (Crowell & Kuhn, 2014). Therefore, educators should apply the development of argumentation skills in learning activities, especially in laboratory activities (Ridwan et al., 2017; Hakim et al., 2020).

The skill to argue in laboratory activities is a concern because several previous studies have shown that the skill to argue in students is very low, with aspects of a claim getting a value of 48%, evidence getting a value of 26%, warrants getting a value of 44%, backing getting a value of 22%, and rebuttal get a value of 37% (Pritasari & Jumadi, 2018). Other studies show that the argumentation skill on campus with students of the physics education department shows critical thinking skills at level 2, with low argumentation skills (Cesariyanti et al., 2022). Meanwhile, in other studies, they also describe their findings in the form of laboratory activities that should pay attention to argumentation skills to improve critical thinking skills and scientific writing because argumentation skills are the initial foundation of other skills (Purnama et al., 2021).

Argumentation skill itself can be improved not only in classroom learning activities but can be improved in laboratory activities. Based on previous research, laboratory activities are activities where students can think of answers to questions carried out by experimentation to produce arguments based on data (Nanto et al., 2022). In addition, laboratory activities are also considered appropriate to improve argumentation skills because students are pressured to present arguments against answers found in experiments (Uzuntiryaki-Kondakci et al., 2021). In essence, laboratory activities are a place to prove a theory or statement, this is included being able to argue based on experimental results, and is not made up on purpose (Demircioğlu, 2022)

Because argumentation skills are essential, many students still have low argumentation skills, so the urgency in increasing argumentation skills is very high. This study proposes a new laboratory activity model called the Sophisticated Thinking Blended Laboratory (STB-LAB) to improve argumentation skills. The STB-LAB laboratory activity model is made based on the LOTS-HOTS transition by making arguments as the disposition of LOTS to HOTS (Agustina et al., 2022). STB-LAB was chosen as the model for laboratory activities in this study because of three main advantages; (1) The syntax contained in the STB-LAB is very suitable for practicing argumentation skills; (2) LOTS-HOTS disposition which is useful for students to develop long-term argumentation skills; and (3) clear and directed systematics of laboratory activities in training argumentation skills to students' critical thinking skills. The STB-LAB laboratory activity model has five syntaxes, namely; (1) The disposition stage; (2) the argumentation stage; (3) The verification stage; (4) The laboratory stage; and (5) The communication stage. In the disposition stage, real-world problems are presented, and students must be able to explore the real-world problems presented. In the argumentation stage, students must choose the arguments presented or make new arguments, then describe the basic theory according to the selected arguments, and explain the arguments according to the selected arguments. The disposition stage and the arguments stage are felt to be able to improve argumentation skills because students can read the circumstances that occur as a problem, and present their arguments because students must adapt to a problem, and will trigger solving the problem with the initial arguments raised (Noroozi et al., 2018). In the verification stage, students are required to verify the experimental results using a virtual laboratory, and then they are required to conclude the experimental results based on statistical tests to strengthen their arguments. In the laboratory stage, students conduct real experiments with tools, materials, and variables according to the virtual laboratory and also graze on the arguments built at the argumentation stage. Then, they are required to conclude the experimental results based on statistical tests to strengthen their arguments. The last stage is the communication stage, where students are required to compare the results of the virtual laboratory with the real laboratory to get a conclusion about the differences so that students are expected to be able to find out what they did not know before to reinforce the argument. Then the students explain their findings and whether the argument it states is right or wrong. With the STB-LAB syntax, students are trained to think independently, carry out laboratory activities independently, collaborate axiologically, and be able to show persuasion to convince their arguments to be correct (Malik et al., 2020; Agustina et al., 2022).

Based on the opinion of previous researchers, the disposition can make students find out theories, to previous data in a case at hand, so that they get initial knowledge about the problems they face (Tikhonova & Kudinova, 2015b). In addition, in arguing, it is required to be provided with preliminary knowledge, so there are no misconceptions and equalized understanding with other students so that the argument remains on track (Tikhonova & Kudinova, 2015a). Based on previous research, students can achieve sophistication if they can transition between LOTS and HOTS by showing that students can argue like researchers, and all arguments are based on data and facts in the field (Tikhonova & Kudinova, 2015a). In addition, students can be declared sophisticated if they can assemble their arguments and find supporters to verify their arguments (Tikhonova et al., 2015).

Based on the use of virtual and real laboratories, the physics content on refraction, especially on the Cauchy index, is considered very suitable for use on both platforms. Because the Cauchy index using a traditional spectrometer virtually can be assembled easily and adjusted to the original. The virtual laboratory development carried out by Amrita Vlab (Vlab.amrita.edu, 2013) is similar to a real laboratory so that the data used in virtual and real are obtained to be homogeneous.

The importance of argumentation skills in conveying an opinion when there is a difference of opinion is one of the things to strengthen one's opinion in an invention so that the ability to argue becomes the main pillar in forming other skills. Also, so far, there have been few studies using the STB-LAB model because the STB-LAB-based laboratory activity model is still very new. This study aims to determine whether the STB-LAB laboratory activity model can improve students' argumentation skills in a real laboratory and virtual laboratory in the physics education major. The use of a virtual laboratory and real laboratory in one class with the same subject applies to the STB-LAB model.

METHODS

This research is a quantitative study with the population of 2nd-semester college students in the Physics Education Department of UIN Sunan Gunung Djati Bandung. The sample is 30 students in the experiment class and 30 in the control class. Both classes used a purposive sampling technique. The research design used is a two-group pretest-posttest which can be seen in Table 1.

Table 1. Two Group Pretest-Posttest Design

Class	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_3	-	O_4

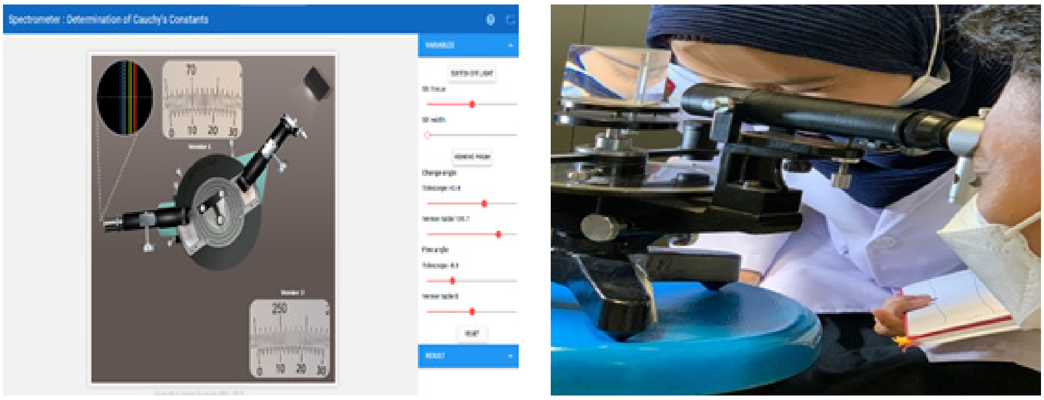
(Adib-Hajbaghery & Karimi, 2018)

Before carrying out the main stages, such as conducting the pretest, treatment, and posttest, the researchers designed a research instrument as an assessment rubric with aspects that can be seen in Table 2. Then, after designing the instrument, the researchers tested the validity of the research instrument. The results of the validity of the questions were carried out by three validators using the product moment test, with an average coefficient of the validity results from three validators obtained of 0.83. The results of the instrument validity showed that all questions used were valid for use. Furthermore, the reliability test using Cronbach's Alpha showed that the reliability results obtained were 0.87.

Table 2. Argumentation Skills Aspects and Type of Question in Question Sheet

Aspects	Type of Question	Number of Question
Claim	Real-world problems are presented with three different opinions. Then students are required to choose which opinion is logical according to the views of each student.	1, and 2
Evidence	Real-world problems are presented, and students are required to explain previous research according to applicable theory and in line with the intent of the real-world problems presented.	3, and 4
Warrant	Real-world problems presented are similar to the real-world problems in the evidence aspect, but students are required to reanalyze the relationship between data and claims.	5, and 6
Backing	Real-world problems are presented with initial secondary data, students are required to explain the basis of the truth to support the claims in the real-world problems presented.	7, and 8
Rebuttal	Real-world problems are presented with no opinions or secondary data, so students must analyze from the beginning to get conclusions based on claims, evidence, warrants, and backing.	9, and 10

The independent variable used in this study is the STB-LAB model, which had been previously developed by Agustina and Putra (Agustina et al., 2022). The pretest was carried out before the treatment, with the subjects filling in questions that had been developed based on the aspects seen in Table 2. The pretest stage was intended to obtain initial data in the form of argumentation skills. After the pretest, treatment was carried out using STB-LAB on the refractive material, especially the Cauchy constant. The steps used in laboratory activities based on STB-LAB were; (1) Disposition stages; (2) Argumentation stages; (3) Verification stages; (4) Experimental stages; and (5) Communication stages. The subjects conduct the disposition stage to understand the concept of refraction based on real-world problems. The argumentation stage is conducted by the subjects to provide their arguments against the real-world problems presented by giving initial opinions on a problem that is complemented by hypotheses that will be obtained later. The results of the arguments given by the subject will be submitted to the lecturer or assistant lecturer, who later students explain why they chose that opinion. Then the verification stage is conducted by the subjects to carry out literacy studies by looking for data from previous research findings regarding the Cauchy experiment along with the data and its processing. The experimental stage is conducted by the subjects to carry out virtual experiments using virtual and real laboratories using traditional spectrometers, which the experiment can be seen in Figure 1.



(a) (b)

Figure 1. Experiment Using (a) Virtual Laboratory (https://vlab.amrita.edu/index.php?sub=1&brch=281&sim=1514&cnt=4) and (b) Real Laboratory

The final stage is the communication stage, conducted by the subjects to convey their findings by presenting in front of the class, where other students comment on the findings of the group presenting the results. Researchers took data at the treatment stage on the subject's argumentation skills when carrying out the argumentation and communication stages. In addition, the research report data conducted by the subject were assessed based on aspects of argumentation skills. After the treatment, a posttest was carried out to get the results after using the STB-LAB on refractive material, which of course, focused on argumentation skills. The dependent variable in this study is argumentation skills. The control class uses the same material, and the use of real and virtual laboratories is similar, but the treatment used is different. The treatment given to the control class uses a traditional model, such as a cookbook laboratory.

In the pretest, students' argumentation skills were tested using an argumentation skill test which contained questions related to refraction that were specifically focused on the Cauchy constant. Each real-world problem presented in the question contains ten questions that students must answer, with one aspect containing two questions regarding argumentation skills in detail which can be seen in Table 2. The same questions and rules are also applied to the posttest using the questions and rules according to Table 2. All the results of scores such as pretest scores, argumentation scores, report scores, and posttest scores are used in seeking to improve argumentation skills.

The results of the argumentation skills test were used in data collection with an instrument in the form of a test sheet containing ten questions whose aspects and types of questions can be seen in Table 2. The answers that students must answer consist of short answers and long answers. Long answers are answers that contain the reasons behind the short answers given by students. Then, the students' results are assessed, and the researchers looked for the N-Gain from the pretest and posttest results conducted by the students with the N-Gain classification, which can be seen in Table 3.

Table 3. N-Gain Classification

Percentage (%)	Desctiprion
< 40	Not Effective
40 – 55	Less Effective
56 – 75	Fairly Effective
> 76	Effective

(Lastriningsih, 2017)

After looking for the N-Gain, the researchers conducted a normality test before testing the hypothesis using the paired sample t-test, first testing the normality of the data using the K-S test. The homogeneity test is not used in data analysis because the class used is only one class, and there is no comparison class. The homogeneity test is used only when there are differences in the subjects in the two classes (Kim & Cribbie, 2018). Then, hypothesis testing answers the results of the research conducted by testing the hypothesis of the paired sample t-test type, which has the hypothesis in Table 4. All data obtained were analyzed using IBM SPSS Statistics 26.0.

Table 4. Research Hypothesis

Decision	Description
Sig. < 0.05	Accept H_0 Reject H_a, Effective to increase argumentation skill after using the STB-LAB laboratory activity model
Sig. > 0.05	Reject H_0 Accept H_a, Not Effective in argumentation skill after using the STB-LAB laboratory activity model

Furthermore, this study will look for how significant the effect of increasing in argumentation is when using the STB-LAB model on two platforms, namely by using Cohen's D Effect Size, where the results of the pretest and posttest values from using the two platforms will be tested. The results obtained in the Cohen's D Effect Size test use the mean of each platform as the numerator and the standard deviation of each platform as the denominator. Then the findings can be divided by 10 to show the effect size results (Kraft, 2020; Wisniewski et al., 2020). The main effectiveness results were shown by hypothesis testing, and the increasing effect was shown by Cohen's D Effect Size test results. The Cohen's D Effect Size test results can be interpreted with the guidelines in Table 5.

Table 5. Cohen's D Effect Size Interpretation

Cohen's D	Interpretation
0 – 0.2	Weak Effect
0.21 – 0.50	Modest Effect
0.50 – 1.00	Moderate Effect
> 1.00	Strong Effect

All methods that have been described will be used for two laboratory activities, namely real laboratory activities and virtual laboratory activities in two classes and carried out during two quartiles, with details; the first quartile used a virtual laboratory in quartile 3 (July - September and the second quartile used a real laboratory in quartile 4 (October – December).

RESULTS AND DISCUSSION

Based on the method that has been described, the researchers will conduct an N-Gain test based on the results of the pretest and posttest of each of 30 students from 2nd-semester college students in the Physics Education Department of UIN Sunan Gunung Djati Bandung in two classes using virtual laboratory activities and real laboratory activities.

The results of the pretest, posttest, and N-Gain obtained from every aspect of argumentation skill in the use of a virtual laboratory can be seen in Table 6.

Table 6. Average of Pretest, Posttest, and N-Gain Scores of Argumentation Skills Aspect in Virtual Laboratory Usage

Class	Aspects	Type	Score	Category
Experiment	Claim	Pretest	22.083	Very Low
		Posttest	82.083	High
		N-Gain	76.698	Effective
	Evidence	Pretest	17.083	Very Low
		Posttest	81.250	High
		N-Gain	76.735	Effective
	Warrant	Pretest	19.166	Very Low
		Posttest	78.750	Enough
		N-Gain	72.873	Effective Enough
	Backing	Pretest	18.750	Very Low
		Posttest	83.750	High
		N-Gain	79.769	Effective Enough
	Rebuttal	Pretest	18.333	Very Low
		Posttest	86.250	Very High
		N-Gain	82.726	Effective
Control	Claim	Pretest	21.241	Very Low
		Posttest	57.541	Low
		N-Gain	45.782	Less Effective
	Evidence	Pretest	24.985	Very Low
		Posttest	57.708	Low
		N-Gain	43.252	Less Effective
	Warrant	Pretest	20.314	Very Low
		Posttest	58.706	Low
		N-Gain	48.041	Less Effective
	Backing	Pretest	23.185	Very Low
		Posttest	57.716	Low
		N-Gain	44.653	Less Effective
	Rebuttal	Pretest	24.771	Very Low
		Posttest	57.285	Low
		N-Gain	42.976	Less Effective

The results in Table 6, especially in the experiment class, show that those who get the effective N-Gain category are in aspects; (1) Claims; (2) Evidence; (3) Backing; and (4) Rebuttal. Meanwhile, in the warrant aspect, the results are below other aspects, which are in the quite effective category. Table 5 also shows that the highest N-Gain results on using STB-LAB in virtual laboratory activities are in the Rebuttal aspect, and the lowest results are in the Warrant aspect. The average N-Gain results obtained on argumentation skill are 78.167, which are included in the effective category, with an average pretest result of 19.083, and an average posttest of 82.416.

Furthermore, the results shown in Table 6, especially in the control class, all the N-Gains obtained are believed to be in the less effective category. In retrospect, in the control class, the lowest N-Gain was in the Rebuttal aspect, with the results obtained in the amount of 42.976, and the highest in the control class, namely in the Warrant aspect, with the results obtained in the amount of 48.041. The average N-Gain result obtained on argumentation skills in the control class is 44.941, which falls into the less effective category, with an average pretest result of 22.899, and an average posttest of 57.791. Then, the average results of the pretest, posttest, and N-Gain in the use of a real laboratory, can be seen in Table 7.

Table 7. Average of Pretest, Posttest, and N-Gain Score of Argumentation Skills Aspects in Real Laboratory Usage

Class	Aspects	Type	Score	Category
Experiment	Claim	Pretest	22.083	Very Low
		Posttest	85	Very High
		N-Gain	80.261	Effective
	Evidence	Pretest	17.083	Very Low
		Posttest	76.666	Enough
		N-Gain	71.111	Effective Enough
	Warrant	Pretest	19.166	Very Low
		Posttest	75.833	Enough
		N-Gain	69.063	Effective Enough
	Backing	Pretest	18.750	Very Low
		Posttest	82.916	High
		N-Gain	78.817	Effective
	Rebuttal	Pretest	18.333	Very Low
		Posttest	78.75	Enough
		N-Gain	72.881	Effective Enough
Control	Claim	Pretest	27.841	Very Low
		Posttest	55.875	Low
		N-Gain	38.142	Not Effective
	Evidence	Pretest	25.351	Very Low
		Posttest	55.408	Low
		N-Gain	39.947	Not Effective
	Warrant	Pretest	24.341	Very Low
		Posttest	57.341	Low
		N-Gain	43.454	Less Effective
	Backing	Pretest	26.675	Very Low
		Posttest	57.151	Low
		N-Gain	41.207	Less Effective
	Rebuttal	Pretest	24.792	Very Low
		Posttest	58.450	Low
		N-Gain	44.486	Less Effective

The results shown in Table 7, especially in the experiment class, show that those who get the effective N-Gain category are in aspects; (1) Claims; and (2) Backing. While the N-Gain category is quite effective in aspects; (1) Evidence; (2) Warrants; and (3) Rebuttal. The average N-Gain result obtained on argumentation skill is 74.972, which falls into the quite effective category, with an average pretest result of 19,083, and an average posttest of 79.833.

Furthermore, the results shown in Table 7, especially in the control class, show that those who get the less effective N-Gain category are in aspects; (1) Warrant; (2) Backing; and (3) Rebuttal. The average N-Gain result obtained on argumentation skills in the control class is 41.447, which falls into the less effective category, with an average pretest result of 25.800, and an average posttest of 56.485. Overall, the pretest results obtained in the experiment class are classified as very low. The low pretest is because students have not been given treatment in the form of STB-LAB in real and virtual laboratory activities. The pretest results obtained were the same because the STB-LAB series were in treatment, while the pretest was carried out before the treatment.

Table 8. Results of Normality Test in Argumentation Skills

Aspect	Score in	Type	Mean Score	Normality
Claim	Pretest	Virtual Laboratory	22.083	0.065
	N-Gain		76.698	0.070
	Pretest	Real Laboratory	22.083	0.065
	N-Gain		80.261	0.061
Evidence	Pretest	Virtual Laboratory	17.083	0.077
	N-Gain		76.746	0.055
	Pretest	Real Laboratory	17.083	0.077
	N-Gain		71.111	0.068
Warrant	Pretest	Virtual Laboratory	19.167	0.066
	N-Gain		72.873	0.058
	Pretest	Real Laboratory	19.167	0.066
	N-Gain		69.063	0.069
Backing	Pretest	Virtual Laboratory	18.750	0.084
	N-Gain		79.769	0.073
	Pretest	Real Laboratory	18.750	0.084
	N-Gain		78.817	0.121
Rebuttal	Pretest	Virtual Laboratory	18.333	0.200
	N-Gain		82.726	0.150
	Pretest	Real Laboratory	18.333	0.200
	N-Gain		72.881	0.139
Total Aspect in Experiment Class	Pretest	Virtual Laboratory	19.083	0.133
	N-Gain		78.167	0.200
	Pretest	Real Laboratory	19.083	0.133
	N-Gain		74.972	0.119

Normality test is one of the absolute requirements for hypothesis testing in the form of paired sample t-test, which will later be used as a reference in making hypotheses in increasing argumentation skill. The paired sample t-test type hypothesis test does not require conditions such as the homogeneity test because, in the paired sample t-test, homogeneity is not an absolute requirement. After all, the sample reviewed is one data at a time, not as a whole (Mishra et al., 2019). Based on Table 8, the claim aspect shows normality results in the pretest and N-Gain. Both types of laboratory use get normal data results, which show that the Sig value of the pretest in the virtual laboratory type is 0.065, and the virtual laboratory type N-Gain gets a Sig. of 0.065. The results of the normality decision obtained in the claim aspect of the virtual laboratory type are Sig. > 0.05, which means that the pretest and N-Gain data on the claim aspect of the virtual laboratory are normal. In addition, in the real laboratory, the value of Sig. The pretest and N-Gain obtained are 0.065 and 0.070. The results of the normality decision obtained on the claim aspect of the real laboratory type are Sig > 0.05, which means that the pretest and N-Gain data on the claim aspect of the real laboratory are normal.

Table 8 also shows in the aspect of the evidence that the results of normality in the pretest and N-Gain in both types of laboratory use get normal data results, which are indicated by the value of Sig. of the pretest in the virtual laboratory type of 0.077, and N-Gain of the Sig. of 0.055. The results of the normality decision obtained in the virtual laboratory type evidence aspect are Sig > 0.05, which means that the pretest and N-Gain data in the virtual laboratory evidence aspect are normal. In addition, in the real laboratory, the value of Sig. pretest and N-Gain obtained are 0.077 and 0.068. The results of the normality decision obtained in the real laboratory type of evidence aspect are Sig > 0.05, which means that the pretest and N-Gain data in the real laboratory evidence aspect are normal.

Table 8 also shows that in the warrant aspect, the results of normality in the pretest and N-Gain in both types of laboratory use get normal data results, which are indicated by the value of Sig. in the virtual laboratory type pretest, the result is 0.066, and in the virtual laboratory type N-Gain, the result is Sig. of 0.058. The results of the normality decision obtained in the virtual laboratory type warrant aspect are Sig > 0.05, which means that the pretest and N-Gain data on the virtual laboratory warrant aspect are normal. In addition, in the real laboratory, the value of Sig. pretest and N-Gain obtained are 0.066 and 0.069. The results of the normality decision obtained on the warrant aspect of the real laboratory type are Sig > 0.05, which means that the pretest and N-Gain data on the warrant aspect of the real laboratory are normal.

Table 8 also shows the backing aspect which shows normality results in the pretest and N-Gain in both types of laboratory use to get normal data results, which shows the value of Sig. in the virtual laboratory type pretest, the result is 0.084, and in the virtual laboratory type N-Gain, the result is Sig. of 0.073. The results of normality decisions obtained in the virtual laboratory type backing aspect are Sig > 0.05, which means that the pretest and N-Gain data in the virtual laboratory backing aspect are normal. In addition, in the real laboratory, the value of Sig. pretest and N-Gain obtained are 0.084 and 0.121. The results of the normality decision obtained in the backing aspect of the real laboratory type are Sig > 0.05, which means that the pretest and N-Gain data on the backing aspect of the real laboratory are normal.

Table 8 also shows the rebuttal aspect which shows normality results in the pretest and N-Gain in both types of laboratory use to get normal data results, which shows the value of Sig. in the virtual laboratory type pretest the result is 0.200, and the virtual laboratory type N-Gain gets the Sig. of 0.150. The results of the normality decision obtained in the rebuttal aspect of the virtual laboratory type are Sig > 0.05, which means that the pretest and N-Gain data in the rebuttal virtual laboratory aspect are normal. In addition, in the real laboratory, the value of Sig. pretest and N-Gain obtained are 0.200 and 0.139. The results of the normality decision obtained in the rebuttal aspect of the real laboratory type are Sig > 0.05, which means that the pretest and N-Gain data in the real laboratory rebuttal aspect are normal.

Overall results obtained from all aspects of argumentation skill, in Table 8 show that the results of Sig. obtained in normality in the pretest and virtual laboratory type N-Gain get 0.133, and 0.200 respectively. Results of Sig. The results obtained in the virtual laboratory type showed normal results in the pretest and N-Gain with the decision taken, namely Sig. > 0.05. While in the real laboratory type, the results of Sig. pretest and N-Gain obtained are 0.113 and 0.119. The results obtained in the real laboratory type showed normal results in the pretest and N-Gain with the decision taken, namely Sig. > 0.05. All data obtained in the study were normal, then to determine whether or not there was an increase in argumentation skill when using STB-LAB in a virtual or real laboratory, a paired sample t-test was conducted to test the hypothesis. The results of the paired sample t-test type hypothesis test can be seen in Table 9.

Tabel 9. Paired Sample T-Test Results on Argumentation Skills in STB-LAB Usage for Virtual and Real Laboratory

Type	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Virtual Laboratory	63.333	6.9584	1.2704	60.7350	65.9316	49.852	29	0.000
Real Laboratory	60.750	7.6325	1.3935	57.9000	63.6000	43.596	29	0.000

Table 9 shows that the use of STB-LAB can improve students' argumentation skills, with the results of Sig. (2-tailed) obtained is 0.000. Based on the decision-making guidelines, if Sig. (2-tailed) < 0.05 then there is an increase after treatment (Priyadi et al., 2018). Based on Table 8, shows that the results of using STB-LAB in virtual laboratory activities and real laboratory activities get Sig. (2-tailed) < 0.05, or in other words, STB-LAB can effectively improve students' argumentation skills in virtual laboratory activities and real laboratory activities. Furthermore, in finding out how big the effect is from the increase between the use of two platforms based on STB-LAB, an effect size test is carried out, the results of which can be seen in Table 10.

Table 10. Cohen's D Effect Size Results on the Use of Two Platforms in Experimental Class

Type	Mean	Std. Dev	Cohen's D Effect Size
Virtual	63.33	6.95	0.91
Real	60.75	7.63	0.79

Table 10 shows the effect size results from the use of the two platforms in the experiment class that the use of a virtual laboratory gets a value of 0.91, or with the interpretation that the effect is high. In real laboratory use, it gets a value of 0.79, or with the interpretation that the effect is moderate.

The finding indicates that the lowest aspect of virtual laboratory platform usage is the Warrant aspect where experienced by students because students are less observant in reasoning data to form claims. After all, refraction laboratory activities produce a lot of data, so students are overwhelmed with reading data. Low data readability can result in misinformation of important detailed information so that when forming a claim, students will miss important small details (Faize et al., 2017). Due to the low warrant, it will have an impact on the evidence, namely looking for other evidence to support the claim, so that the evidence in the form of incomplete data will result in a lack of evidence to support the claim. A lack of evidence to support the claim can lead to doubts about the arguments presented, so the claim can be said to be weak because the data presented is not supportive (Ping et al., 2020). Based on Table 6 in the experimental class show that rebuttal gets the highest results in N-Gain, this is because rebuttal does not need other claims, only rebuttals are found in the findings, so the refutation does not require complicated systematics. This is in line with research conducted by previous research, which states that rebuttal does not require a high series of complexities because rebuttal only focuses on refutation based on previously built claims (Buber & Coban, 2017).

Based on real laboratory usage in Table 7, the highest N-Gain results in the use of STB-LAB in real laboratory activities are in the Claim aspect, and the lowest is in the Warrant aspect. Just like in virtual laboratory activities, the Warrant aspect gets low results, because students do not read carefully about the data presented to form claims. While the highest results are in the Claim aspect, where in the Claim, students do not need to bother making claims, because students only need to read the problem and make claims according to their knowledge. Claims in argumentation skill are the initial stage in continuing the next aspect, so claims do not require deep thought and do not need to be long-winded in proving (Dvořák et al., 2021). So that in claims, students are required to be more careful with the relevance of the findings and research objectives (Bråten et al., 2014) Based on previous research, claims do not require deep thinking skills, so students can easily make claims in argument skill with various skills (Kind et al., 2011). In addition, claims can be made by anyone without any proof, because claims are the same as hypotheses in a problem but in the realm of argumentation (Ping et al., 2019).

The results of virtual laboratory activities shown in Table 6 experimental class are higher than the results of using real laboratory activities shown in Table 6 experimental class. The high result of argumentation skills in virtual laboratory activities is because virtual laboratories are considered easier to use and can also be efficient time (Potkonjak et al., 2016). In addition, previous research revealed that using a virtual laboratory can make students more quickly find evidence to meet evidence in argumentation skills (Malik & Ubaidillah, 2021; Putra et al., 2021). Other previous studies also revealed that using a real laboratory will take more time than using a virtual laboratory, so when students do backing, it will be easier to do virtual laboratory activities than real laboratory activities (Roviati et al., 2017). Other research also states that the ease of thinking of students when carrying out laboratory activities is when using a virtual laboratory platform because the virtual laboratory platform can make students more visualized about a concept so that students can easily imagine even abstract concepts (Vergara et al., 2022).

There were no results that received a low increase on average, not even in the effect size, no one got a low result in STB-LAB usage, because STB-LAB can facilitate students' argumentation skills with an argumentation session in its syntax. Previous research stated that the ability to argue can be improved with a model that has syntax with the aim of increasing the ability to argue (Wang et al., 2015). In addition, the opinions of other researchers also stated that the laboratory activity model should provide a special syntax for arguing in its activities because the ability to reason alone is challenging to apply in a laboratory activity model (Cetin, 2014; Fischer et al., 2014).

The results of the N-Gain acquisition are reinforced by the acquisition of Effect Size results, which is based on Table 10, that the use of a virtual laboratory has a high effect, this is because the use of a virtual laboratory can be easily understood, without misinformation about the use of tools. A virtual laboratory is believed to help make it easier for students to search for data, so its use is often intended for understanding the working of tools (Budai & Kuczmann, 2018). In addition, Table 10 also shows that the use of a real laboratory has a moderate effect. This is believed to have an effect on the ability to argue, because the use of real laboratory can raise many questions when the tools used have errors (Krasnova & Shurygin, 2020).

The STB-LAB laboratory activity model in its syntax can provide space for extensive argumentation, even being guided by lecturers or teaching assistants in arguing. Students are also required to validate after providing initial hypotheses to strengthen their arguments later. According to previous research, in arguing, educators should take part in guiding their students because sometimes students' arguing does not fulfill the backing aspect because sometimes students are confused in finding sources of the basis for their arguments (Osborne, 2014). In addition, according to other studies, in improving the ability to argue, it is better to provide ample space for students to validate before arguing, so that the syntax for validating students' findings before arguing is needed to be efficient in improving their argumentation skills. (Goldman et al., 2016; Jonassen & Carr, 2020)

CONCLUSION

This study finds that the N-Gain test carried out on the use of the STB-LAB learning model in virtual and real laboratory activities increased, with the total category in virtual laboratory activities being effective with an acquisition score of 78,167, and the total category in real laboratory activities which is quite effective with an acquisition score of 74,972. In addition, in making decisions using the paired sample t-test type hypothesis test, the results of Sig. (2-tailed) of 0.000 for virtual laboratory activities and real laboratory activities. In terms of acquisition results Sig. (2-tailed) shows that the hypothesis taken is accept H0 reject Ha, or in other words, there is an increase in argumentation skill when using the STB-LAB learning model in virtual and real laboratory activities for students. This study shows that the Sophisticated Thinking Blended Laboratory (STB-LAB) learning model can improve argumentation skills at the undergraduate level due to the special syntax to provide freedom of argument so that undergraduate students' argumentation skills are trained. Especially in the use of virtual laboratories for laboratory activities, undergraduate students tend to be able to improve their argumentation skills higher than in the use of real laboratories, because in a virtual laboratory, it tends to be easier to visualize abstract concepts, so undergraduate students can easily understand the meaning of an abstract concept, and can easily looking for some information as the basis of the argument.

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