Full research paper

COLLABORATIVE LEARNING BASED ON SOPHISTICATED THINKING LABORATORY (STB-LAB) AND GATHER TOWN AS GAMIFICATION TOOL FOR BLENDED LABORATORY ON SCIENCE UNDERGRADUATE STUDENTS

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ABSTRACT

The evolution of learning design continues, focusing on blended laboratory approaches incorporating technology. The Sophisticated Thinking Laboratory (STB-LAB) and Gather Town are key tools in implementing collaborative learning in this context. This study assesses the effectiveness of blended laboratory implementation using STB-LAB and Gather Town as a gamification tool, utilizing the Assessment Based on Teaching and Learning Trajectory (AABTLT) with Student Activity Sheets (SAS). The results reveal the successful execution of STB-LAB syntax in blended laboratory activities. Additionally, STB-LAB and Gather Town significantly enhance students' collaborative skills, as indicated by a substantial Cohen's D Effect Size. For physics education majors, the effect size is 1.736 in the experiment group and 0.754 in the control group, while for biology education majors, it is 1.522 in the experiment group and 0.541 in the control group. This study highlights the positive impact of blended laboratories with STB-LAB and Gather Town on collaborative skill development, further emphasizing the role of technology in contemporary learning design.

KEYWORDS

Blended laboratory, collaborative learning, collaborative skills, gather town, STB-LAB

HOW TO CITE

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Highlights

- *The implementation of blended laboratory activities using the STB-LAB model assisted by Gather Town as a gamification tool has achieved good results.*
- *The results of the hypothesis testing show that there is an increasing effect on collaborative skills when using the STB-LAB model.*
- *Gather Town shows features that can be used to carry out blended laboratory activities.*
- *The enhancement effect shows that there is a large effect for the experiment group in the physics education major and biology education major.*

INTRODUCTION

21st-century skills are skills needed to support life in the future. These 21st-century skills are an important component in the world of education, especially for the next generation of successors who will enable them to build and bring about change on a national or global scale (Van Laar et al., 2017). The importance of 21st-century skills is demonstrated by the rapid development of science and technology, where advances in various technologies require qualified skills to control or create technology (Jacobson-Lundeberg, 2016).

21st-century skills, characterized by 4C as the main skills, include; (1) Critical thinking skills; (2) Creative thinking skills; (3) Communication skills; and (4) Collaborative skills. The 4C skills are expected to facilitate students in supporting their lives later when they enter the world of work so that these students are able to compete on a global scale (Chalkiadaki, 2018). However, fulfilling the 4C skills requires a process, and, of course, there is one skill that is difficult to practice (Punya Mishra and Mehta, 2017). One example of a skill that is difficult to train is collaborative skills because, in collaborative skills, it is sometimes difficult for educators to monitor all activities carried out by students (Rahman et al., 2019). In addition, collaborative skills are difficult to train because sometimes students feel indifferent to what is given by their educators because they feel that they are not being cared for by educators (Hur, Shen and Cho, 2020).

The difficulty in training 21st-century skills is due to various background factors, one of which is the condition factor that changes habits or transformations in the world of education (Bell, 2016). Changes in habits in the world of education that are often felt in the 21st century are when a pandemic occurs, which limits human activities such as learning and teaching. One of the difficulties when carrying out virtual learning is monitoring students in collaborative learning (Koşar, 2021). We believe that the pandemic will provide new changes or transformations in the world of education, in which many new innovations will emerge, such as the opinion expressed by Chick (2020), which states that innovation occurs due to the pressure of circumstances that make people think of seeking other alternatives as one of the conveniences in carrying out activities. In addition, Kang (2021) argues that innovation in education during a pandemic is shown by the many innovative learning models and methods that make it possible to do without or with minimal physical contact. In addition, we need media that can accommodate virtual, real, or blended learning activities. Because a medium used in learning activities is felt to be able to bring interest, even ease in the process of transferring knowledge in learning (Williamson, Eynon and Potter, 2020).

Many innovations have sprung up and been developed in the world of education, especially in learning models; of course, they must be studied more deeply by analyzing the syntax of the learning model. In the learning model innovations that emerged during the pandemic, one of them was carried out by Agustina, Putra, and Listiawati (2022), where they developed a laboratory activity-based learning model that combines virtual and real called the Sophisticated Thinking Blended Laboratory (STB- LAB). STB-LAB has a syntax that combines virtual and real activities into a unified learning design, in which STB-LAB combines LOTS and HOTS as a skill foundation to fulfill 21st-century skills. The syntax owned by STB-LAB is deemed qualified to support the skills requirements of the 21st Century, where the syntax is; (1) Disposition stages; (2) Argumentation stages; (3) Verification stages; (4) Laboratory stages; and (5) Communication stages. The five stages of the STB-LAB are certainly felt to be able to train collaborative skills in collaborative learning because there is two-way learning between educators and students, both virtually and in real terms. Collaborative learning at STB-LAB is, of course, focused on the argumentation stage, up to the laboratory stage because these stages have two-way characteristics, where when students give arguments against a problem, there will be comments from educators so that students design their arguments well and perfect where of course the ability to argue is properly trained using the STB-LAB model (Agustina and Putra, 2022). Furthermore, at the verification stage, the students are expected to be able to seek verification of the arguments formed per group so that the group can exchange ideas with one another, but still, at the verification stage, it is monitored by the educator so that misunderstandings do not occur. At the laboratory stage, all groups that have been formed conduct real and virtual experiments to test their arguments.

Using the STB-LAB model in blended laboratories certainly requires a media that supports students in carrying out laboratory activities. Of course, the media used must have uniqueness and adequate features, such as media that can be used as a gamification tool (Sailer and Homner, 2020). This gamification will certainly make it interesting for students to carry out learning activities because an attractive visual appearance will stimulate students. As if they are playing a game, but in fact, they are carrying out learning activities (Majuri, Koivisto and Hamari, 2018). In addition, gamification in blended learning or blended laboratory activities must have several features, including being able to display screen videos and face videos and open other media applications (Hallifax et al., 2019).

One possible media is Gather Town, which in Gather Town has features that support carrying out blended learning or blended laboratory because Gather Town has qualified features such as accommodating up to 40 users in a free account (Zhao and McClure, 2022). In addition, Gather Town is also able to display user screens as share screens for each user, so not only one share screen can be displayed, but all participants can share screens simultaneously, which, of course, makes it easier for students to discuss and carry out laboratory activities (McClure and Williams, 2021). Also, Gather Town has pixel visuals like the appearance of a game in the 90s, which has a certain appeal with users being able to change the characters' appearance and decorate the place that will be used as a certain room (Fitria, 2021). The decorations that can be used are very diverse and have their own functions in their features; for example, there is a blackboard that can be used as a feature for writing like a virtual whiteboard, and there are also posters or televisions to display static images or display videos that have buttons to trigger the video when other users want to see what's in the video (Latulipe and De Jaeger, 2022; Lee et al., 2023).

With the syntax that is owned by STB-LAB and the features that Gather Town owns, it is felt that it is possible to make collaborative learning work well, so this research has two objectives, namely to find out how well the implementation of blended laboratory activities based STB-LAB with the help of Gather Town as a gamification tool for blended laboratory and finding out how STB-LAB influences with the help of Gather Town in the implementation of collaborative learning can improve students collaborative skills while carrying out blended laboratory activities. The hypothesis designed in this study is that there is a positive difference in the average score between the pretest and post-test for the ability to collaborate in the experimental group or the group using the STB-LAB model, so the STB-LAB can improve students' collaborative skills. The hypothetical design is applied to major physics education and biology education.

METHOD

This research uses a quasi-experimental method, where it focuses on finding quantitative results, which will later be described as a whole from a series of learning activities using the STB-LAB model assisted by Gather Town as a gamification tool. The Blended Laboratory is used because the STB-LAB model has the characteristics of combining two laboratory activities virtually or in real terms. This laboratory activity was carried out for three meetings.

PARTICIPANTS

This study used 122 students as subjects from two different majors at the same university. The majors used in this research are physics education and biology education. The details of the participants used by the researcher can be seen in Table 1.

Major	Participants	Gender	
		Male	Female
Physics Education	62	36	26
Biology Education	60	22	38
Total	122	58	64

Table 1: Participant description

All participants used in this study were in the same semester, namely in the second semester of the 2021/2022 academic year. Participants were not informed that research would be carried out, so all participants went naturally, without any contrivance. Furthermore, the participants were divided into two groups in their respective departments, with the group design used as two pretest-posttest groups. This means that each department has two different groups, namely the control and experimental groups. In total, there are four groups, namely the control group in Physics Education major and Biology Education. At the same time, the experimental class also has the same grouping as the control group, as the distribution of the control and experimental groups can be seen in Table 2.

Major	Group	Number of Participants
Physics Education	Experiment	31
	Control	31
Biology Education	Experiment	30
	Control	30

Table 2: Group description

In detail, the groups in the physics education major were divided into two groups of a total of sixty-two participants, with an experimental group of thirty-one subjects and a control group of thirty-one subjects. In addition, the division of the experimental and control groups in the biology education major was the same as the physics education major, where a total of sixty participants were divided into two. In this case, the experimental and control groups use different subjects, so the subjects in the experimental and control groups are not the same. In contrast, in the physics and biology education majors, there are three classes in each generation, and each major uses one class for the experimental and control classes. In detail, when major physics education has three classes, namely A, B, and C, in the second semester, class a will be the experimental group, and class B will be the control group. The determination of the experimental and control groups in the biology education major is the same as described in the determination of the experimental and control groups in the physics education major.

Laboratory Activities Description

Laboratory activities are carried out in two conditions, namely using a virtual laboratory and a real laboratory, for the activity model using the STB-LAB model, with gamification media using Gather Town as a means of communication between participants who carry out real laboratory activities, and real laboratory activities that can be seen in Figure 1.

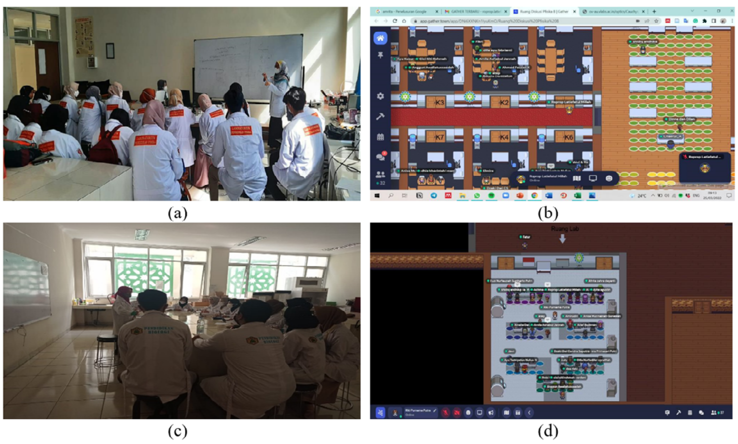

Figure 1: (a) Real laboratory class on physics education; (b) Virtual laboratory class on physics education; (c) Real laboratory class on biology education; and (d) Virtual laboratory class on biology education

As for the Physics Education major, it uses refraction material with tools in the form of a traditional spectrometer for a real laboratory and a traditional virtual spectrometer using a virtual laboratory made by Amrita (https://vlab.amrita.edu/) for a virtual laboratory. In addition, the Biology Education major uses drosophila material, with the tools used in the form of stereo microscopes and monoculars for real laboratories and the use of virtual observations made by FlyLab JS (https://www.sciencecourseware.org/) for virtual laboratories.

Instruments

The instruments used in this study were used to observe the implementation of collaborative learning when using STB-LAB media assisted by Gather Town as a gamification tool. The implementation of collaborative learning is based on the assessment of the implementation presented by several researchers, such as (1) Knowledge Construction (KC); (2) Instructional Activities (IA); (3) Anti-competition (AC); (4) Group Participation (GP); and (5) Social Interaction (SI) (Le, Janssen and Wubbels, 2018; Strijbos, 2016). The entire process of laboratory activities is measured for its implementation using an assessment of the implementation of the Assessment Based on Teaching and Learning Trajectory (AABTLT) with Student Activity Sheet (SAS) developed by Rochman (2017), where AABTLT is observed and assessed by observers other than the teacher/assistant who supervises the activities the laboratory. Students will fill in questions in each series of blended laboratory activities in a short time, which later results from AABTLT and SAS will be given a score range of 1 - 5. The average value of the two assessments is sought, so that the assessment will be graded objectively and in detail. The results of implementing blended laboratory activities can be interpreted according to the percentages obtained, which can be seen in Table 3.

Percentage (%)	Performance Interpretation
80 - 100	Very good
60 - 79	Well
40 - 59	Pretty good
20 - 39	Bad
< 20	Very bad

Table 3: AABTLT with SAS interpretation

In addition, the instrument for measuring the results of the collaborative skills of students uses assessment instruments from several researchers, with the aspects used namely: (1) Task focus; (2) Participation; (3) Knowledge sharing; (4) Reliability; and (5) Socio-Cultural.

For the Task focus (TF), the assessment consists of three items based on the assessment conducted by Häkkinen (2017), where the assessment is assessed to determine how consistent the students are in staying focused on the task at hand. An example of the assessment items is: "Students are not distracted by other assignments, so students only do what is assigned".

For Participation (PC), the assessment consists of three assessment items based on the assessment presented by Hesse (2015), where the researcher takes an assessment to find out how students participate in their group individually or in their role as leaders, with this assessment assessed then will know the participation of students in group discussions. An example of the assessment items is: "Students are able to lead the discussion so that there are no distractions during the discussion".

For Knowledge sharing (KS), the assessment consists of four assessment points, which are based on the assessment presented by Care (2016), in which the assessment is assessed to find out how active the student is in sharing opinions according to their capacity. With the benchmark of student activity, it can be seen when these students can explain their knowledge, accept other people's opinions, and correct other people's opinions so that their group can accept them. An example of the assessment items is: "Students are able to give opinions in accordance with the concepts, theories, and problems being faced".

For Reliability (RB), the assessment consists of four assessment points, which are based on the assessment presented by Widana (2018), where the assessment is assessed to find out how the student does not rely too much on others in his work. The assessment is also assessed in a personal review, which allows it to describe whether the student is independent or able to be invited to collaborate with mutually beneficial work with one another. An example of the assessment items is: "Students are able to independently carry out their duties without making it difficult for others".

For socio-cultural (SC), the assessment consists of three assessment items based on the assessment described by de Hei (2020), where the assessment is used to find out how students listen, think, and discuss further in their groups. This assessment is also assessed in a review of interpersonal interactions, allowing it to provide an overview of whether students are actively interacting with their group. An example of the assessment items is: "Students are able to discuss well and have ethics in discussions".

In summary, how the instruments for assessing student collaborative skills per indicator are shown in Table 4.

All assessments to assess collaborative abilities are used by lecturers to observe and assess students' collaborative abilities by providing assessments using a Likert scale of 1 - 5, which is then interpreted as a percentage per indicator or whole indicator.

Indicators	Description	Example for observation
TF	How can the students focus on their tasks and consistently do their role in group	Students are not distracted by other assignments, so students only do what is assigned
PC	How the students can participate in the discussion in their group and how they can lead the group	Students are able to lead the discussion so that there are no distractions during the discussion
KS	How the students share their opinions, knowledge, and ideas with the groups	Students are able to give opinions in accordance with the concepts, theories, and problems being faced
RB	How can the students be independent or help other members of their group to do the task	Students are able to independently carry out their duties without making it difficult for others
SC	How the students interact and respect the members of their groups	Students are able to discuss well and have ethics in discussions

Table 4: Collaborative skills indicator description and example of observation

Meeting Description and Data Collection

This study took data from the experimental and control groups in major physics and biology education. Data were collected using the pretest and posttest, where the instruments used in the pretest and posttest used the instruments previously described. In practice, major physics education and biology education were carried out on the same day, with details of the experimental group being given the STB-LAB treatment model, where the implementation was carried out in the morning class, and the control group was carried out in the afternoon class. The meeting was held in five meetings within one week of one meeting, where the first meeting was a pretest for the researcher to observe the initial collaborative results of the subjects. Then, the second to fourth meeting became a treatment, with details in the experimental class in both major physics education and biology education, carrying out disposition sessions to arguments at the second meeting. The third meeting held a verification and laboratory session, then the fourth meeting held a communication session. In the fifth meeting, a posttest was carried out for the researcher to observe the final collaborative results of the subjects.

Based on the control class and the details of each major physics and biology education meeting, a pretest was conducted for the researcher to observe the students' initial collaborative results. In the second meeting, the presentation of the theory was carried out, followed by the third meeting, where students carried out trials; then, in the fourth meeting, the presentation of the results of trials by students was carried out. In the fifth meeting, a posttest was carried out for the researcher to observe the final collaborative results of the subjects. All observations in both the experimental and control groups in major physics education and biology education were assisted in observing student collaborative assessments with the assistance of three laboratory assistants.

All the implementation of activities is assessed using authentic assessment with AABTLT with SAS, where the implementation of the teacher is assessed by the observer in accordance with the implementation of the syntax. The implementation of students is assessed by giving one or two short questions regarding activities according to the syntax carried out to students which students then carry out. All the work given to students regarding brief questions regarding activities according to the syntax is assessed using a scale of 1 - 5 which will later be used as a percentage. The pretest and posttest regarding a collaborative that researchers value use an assessment with a scale of 1 - 5, which will later be used as a percentage.

DATA ANALYSIS

The data was processed using quantitative analysis to find out how big the percentage of implementation is using the percentage equation as described by Listiawati (2022), which later on this percentage will be analyzed per aspect and as a whole. Where to analyze the implementation of blended laboratory activities based on STB-LAB with the help of Gather Town as a gamification tool, the percentage of implementation is calculated by means of a data review based on the implementation value in each syntax, which is then averaged and made into a percentage of the average results, so that by calculating the percentage implementation with the AABTLT with SAS assessment will answer the first goal with an interpretation of the percentage gain, namely: (1) < 59% (Not Good); (2) 60% - 69% (Less); (3) 70% - 79% (Well); (4) > 80% (Very Good) (Zakwandi, Yuningsih and Setya, 2020).

Then, in testing the hypothesis and to answer the second objective, this study used a paired sample *t*-test, which in testing, because the data used uses different populations in the major and different samples in each group, so that in one major, there is interference in the control class (Kim, 2015). Also, this hypothesis requires a pre-assumption test, which includes a normality test, and a homogeneity test. The normality test used in this study was tested as a whole for data acquisition with the number of samples above status, so the test used two tests, namely Liliefors, and Shapiro-Wilk, which were able to describe normality well in acquisition values that had control and experimental classes with a total subject range of thirty to forty (Razali and Wah, 2011). Furthermore, a homogeneity test using the Levene test was carried out to test whether the data is homogeneous when the samples used between research groups have differences in the number of samples. This will reduce the risk of invalidity of the data to test the hypothesis (Prabhaker Mishra et al., 2019). Meanwhile, testing homogeneity is not mandatory if the hypothesis test is carried out using the paired sample *t*-test because the paired *t*-test only requires a normality test to fulfill the classic assumption test. Also, the paired *t*-test must be in the same number of subjects in each group used (Lakens, 2017), but in this study, a homogeneity test will also be presented to detail the results of the acquisition of statistical data. In addition, this study will also examine the level of effectiveness of using the STB-LAB on students' collaboration skills using Cohen's D Effect Size, which in the Cohen's D Effect Size will be tested based on the mean and standard deviation obtained so that it can clearly describe the size of the effect given during treatment (Lee, 2016). The use of the effect size is based on the fact that the paired *t*-test only describes, in general, the results of decision-making but does not describe the magnitude of the influence, so as a further explanation to detail it again, tests must be used to test these effects, one of which is the Cohen's D Effect Size (Kraft, 2020).

RESULTS AND DISCUSSION

This study obtained results in the form of a percentage of implementation, primary data, normality test, homogeneity test, hypothesis test, and effect size, where the initial results that will be presented are the percentage of implementation to find out the results of the implementation of blended laboratory activities using the STB-LAB model assisted by Gather Town as a gamification tool. Following are the results of the percentage of blended laboratory activities using the AABTLT with SAS assessment, which can be seen in Table 5.

Table 5 shows that, on average, from the three meetings,

Blended Laboratory Activities		Percentage of Activity Implementation (%)		Total Percentage (%)	Interpretation
Meeting	Syntax	Lecturer	Students		
1	Disposition	82.22	80.64	81.43	Very Good
	Argumentation	78.19	83.06	80.62	Very Good
	Verification	82.78	79.03	80.90	Very Good
	Laboratory	83.08	77.41	80.24	Very Good
	Communication	77.39	71.77	74.58	Well
2	Disposition	78.27	76.61	77.44	Well
	Argumentation	80.62	79.83	80.22	Very Good
	Verification	77.42	75.80	76.61	Well
	Laboratory	83.03	72.58	77.80	Well
	Communication	76.72	70.16	73.44	Well
3	Disposition	83.08	79.83	81.30	Very Good
	Argumentation	77.42	83.06	80.24	Very Good
	Verification	82.22	76.61	79.41	Well
	Laboratory	76.72	78.22	77.47	Well
	Communication	82.78	71.77	77.27	Well
Average				78.59	Well

Table 5: Results of the implementation of blended laboratory activities for three meetings based on AABTLT with SAS

the percentage of implementation was 78.59%, with the interpretation of its implementation being in the Well category. The lowest results were from the first meeting, especially in educator activities, namely at the communication stage, which obtained results of 77.39%. In contrast, the highest results were located at the laboratory stage, which obtained results of 83.08%, and the lowest results from the first meeting on student activities, namely at the communication stage as well which got a result of 71.77%, while the highest result was located in the argumentation stage which got a result of 83.06%. At the second meeting, the lowest results were for educator activities, namely at the communication stage, which obtained results of 76.72%, while the highest results were at the laboratory stage, which obtained results of 83.08%, and the lowest results from the second meeting on student activities, namely at the communication stage as well which got a result of 70.16, while the highest result was in the argumentation stage which got a result of 79.83%. At the third meeting, the lowest result was for educator activities, namely at the argumentation stage, which got results of 77.42%, while the highest results were at the disposition stage, which got results of 83.08%. The lowest result from the second meeting was on student activities, namely at the communication stage which gets a result of 71.77%, while the highest result is in the argumentation stage which gets a result of 83.06%.

Description of research findings data on student collaborative assessment, both in major physics education and biology education, which includes the average pretest and posttest scores in each group used in the study, and all assessments are presented per indicator of collaborative ability, which can be seen in Table 6.

Table 6 shows the average value of the experimental and control groups based on their indicators; the experimental group in major physics education obtained the difference in scores between the pretest and posttest of 15.645 points, with a pretest gain of 68.387 and a posttest gain of 84.032. The highest score obtained on the posttest in the major physics education experimental group was on the RB indicator, with a score of 86.329. The control group in major physics education obtained a difference between the pretest and posttest of 8.065 points, with a pretest gain of 68,064 and a posttest gain of 76.129.

The highest score obtained in the post-test control group was on the PC indicator, with a score of 80.115. Based on the results of the difference in the pretest and posttest average scores between the control and experimental classes in major physics education, a difference of 0.323 points in the pretest and 7.903 points in the posttest, with the experimental class being superior to the control class.

Table 6 also provides information on the average scores of the experimental and control groups based on their indicators in major biology education, with the results of the difference in scores between the pretest and posttest in the experimental group of 16.500 points, with pretest gains of 65.666 and posttest gains of 82.166. The highest score obtained in the posttest of the major biology education experimental group was on the RB indicator, with a score of 85.685. The control group in major biology education obtained a difference between the pretest and posttest of 15.533 points, with a pretest gain of 63.633 and a posttest gain of 79.166. The highest score obtained in the post-test control group was on the PC indicator, with a score of 82.905. Based on the difference in the pretest and posttest average scores between the control and experimental classes in major biology education, a difference of 2.033 points was obtained in the pretest and 3.000 points in the posttest, with the experimental class being superior to the control class.

Major	Group	Indicator	Pretest	Posttest	Pretest Total	Posttest Total
Physics Education	Experiment	TF	70.528	79.449	68.387	84.032
		PC	71.629	85.702		
		KS	62.276	82.232		
		RB	66.115	86.329		
		SC	71.388	86.450		
	Control	TF	70.648	76.232	68.064	76.129
		PC	70.635	80.115		
		KS	62.777	74.777		
		RB	65.115	73.405		
		SC	71.148	76.115		
Biology Education	Experiment	TF	65.232	82.105	65.666	82.166
		PC	67.555	78.245		
		KS	60.227	84.528		
		RB	72.135	85.685		
		SC	63.184	80.270		
	Control	TF	65.425	77.227	63.633	79.166
		PC	72.115	82.905		
		KS	63.777	76.135		
		RB	62.343	78.449		
		SC	54.505	81.115		

Table 6: Primary data descriptive

Then, the classic assumption test is carried out by carrying out the normality and homogeneity tests. The first test to be carried out is the normality test based on the major, so this review of the normality test is not carried out thoroughly. Still, it is divided based on the subject in order to detail and detail the normality results, where the normality test can be seen in Table 7.

Major	Data Type	Liliefors			Saphiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Physics Education	Pretest (Experiment)	.147	31	.086	.964	31	.361
	Posttest (Experiment)	.133	31	.173	.935	31	.060
	Pretest (Control)	.128	31	.200	.958	31	.258
	Posttest (Control)	.156	31	.054	.935	31	.059
Biology Education	Pretest (Experiment)	.126	30	.200	.963	30	.378
	Posttest (Experiment)	.156	30	.059	.937	30	.078
	Pretest (Control)	.141	30	.134	.936	30	.072
	Posttest (Control)	.151	30	.079	.955	30	.224

Table 7: Normality test of collaborative skills data in physics education major and biology education major

Table 7 shows that the use of all data is normal, with an alpha (α) used, namely 5%, or 0.05; it can be concluded that if the results obtained for normality show > 0.05, then the decision taken is that the data is normal. None of the data is abnormal from the data used, so the primary data used to test the hypothesis can be used to test the paired sample *t*-test. Still, before that, a homogeneity test will be carried out using the Levene test based on major and broken down into classes per class. The homogeneity test results can be seen in Table 8.

Major	Type	Levene Statistic	df1	df2	Sig.
Physics Education	Pretest	1.303	1	60	.258
	Posttest	1.499	1	60	.226
Biology Education	Pretest	1.640	1	57	.205
	Posttest	.017	1	57	.896

Table 8: Homogeneity test of collaborative skills data in physics education major and biology education major

Table 8 shows that the use of all data is homogeneous, with α used, which is 5% or 0.05; it can be concluded that if the results obtained for homogeneity show > 0.05, then the decision taken is that the data is homogeneous. None of the data is homogeneous from the data used. The results of this homogeneity aim to strengthen the data used so that none of the data is inaccurate in statistical calculations. Furthermore, when the normality and homogeneity tests have been fulfilled, the paired sample *t*-test is carried out to test the hypotheses taken, with the interpretation of decision-making rejecting H_0 if the value of Sig. (2-tailed) obtains a value smaller than α (5%) or does t reject H_0 if the value is Sig. (2-tailed) obtains a value greater than α (5%). As a guideline for making hypothetical decisions, the hypothetical decisions and their description can be seen in Table 9. The results of hypothesis testing using the paired sample *t*-test can be seen in Table 10.

Decision	Description
Sig. (2-tailed) < 0.05	Reject H_0: There is a difference in the average score between the pretest and posttest scores after the treatment
Sig. (2-tailed) > 0.05	Do not reject H_0: There is no difference in the average score between the pretest and posttest scores after the treatment

Table 9: Research hypothesis

Major	Group	Pair Differences							
		Mean	Std. Dev	Std. Error	95% Confidence Interval of the Diff		*t*	df	Sig. (2-tailed)
					Lower	Upper			
Physics Education	Experiment	15.645	9.013	1.619	12.339	18.951	9.665	30	< .001
	Control	8.065	10.699	1.922	4.140	11.989	4.197	30	< .001
Biology Education	Experiment	16.500	10.840	1.979	12.452	20.584	8.337	29	< .001
	Control	5.867	10.849	1.981	1.815	9.918	2.962	29	.006

Table 10: Paired sample t-test for hypothesis decision

Table 10 shows that the paired *t*-test results can be seen in the acquisition of Sig. (2-tailed), where with an α of 5%, or 0.05, the H_0 will be rejected if the value of Sig. (2-tailed) < α, where the results obtained show the value of Sig. (2-tailed) obtained a total value of < .001 for experimental and control groups in the physics education major, which means that in the experiment group, the application of the STB-LAB model assisted by Gather Town as a gamification tool can affect the improvement of students' collaborative skills, and the control group is also able to influence the improvement of students' collaborative abilities. The results obtained show the value of Sig. (2-tailed) for biology education major obtained a total value of < .001 for the experiment group, while the control group obtained a value of 0.006, which means that in the experiment group, the application of the STB-LAB model assisted by Gather Town as a gamification tool can affect the improvement of students' collaborative skills, and the control group is also able to influence the improvement of students' collaborative abilities. Furthermore, to find out the magnitude of the effect, an effect size test is carried out with Cohen's D Effect Size test, with an interpretation of the effect size gain that is obtained if the value is 0.2. The effect is small, 0.5, then the effect is medium, and > 0.8 effect is large, the results of the Cohen's D Effect Size test can be seen in Table 11.

Major	Group	*N*	Mean	Std. Deviation	*t*	Effect Size	Interpretation
Physics Education	Experiment	31	15.645	9.013	9.665	1.736	Large
	Control	31	8.065	10.699	4.197	0.754	Medium
Biology Education	Experiment	30	16.500	10.840	8.337	1.522	Large
	Control	30	5.867	10.849	2.962	0.541	Medium

Table 11: Cohen's D Effect Size results

Table 11 shows that the results of the Cohen's D Effect Size test obtained from the physics education major are equal to 1.736 for the experiment group, where the interpretation obtained is that there is a large improvement effect and for the control group to get a value of 0.754, where the interpretation obtained is that there is a medium improvement effect. The effect size in biology education major is equal to 1.522 for the experiment group, where the interpretation obtained is an effect large improvement, and for the control group to get a value of 0.541, where the interpretation obtained is that there is a medium improvement effect. The results of the two majors show that the effect of using the STB-LAB model with the help of Gather Town as a gamification tool to improve students' collaborative skills is relatively large in terms of improvement.

Based on the results from Table 5, the implementation of blended laboratory activities using the STB-LAB model assisted by Gather Town as a gamification tool was obtained; an average of 78.59% was obtained, with a good implementation category. A good implementation category was obtained because, based on their activities, students usually like laboratory activities more than studying theory. In line with research conducted by Rashidovna (2020), which states that students in the 21st century tend to have an interest in laboratory activities because laboratory activities students feel they have experience as researchers, Estriegana (2019) states that laboratory activities have their characteristics, where students are able to learn theory and also practice based on direct observation or acquisition from experimental results which then obtained experimental data results will be synthesized based on the applicable theory. In its implementation, blended laboratory activities are felt to have their challenges in their implementation because educators carrying out blended laboratory activities must have two focuses; of course, these focuses are sometimes divided, or it could be that one of the activities is not carried out properly (Ożadowicz, 2020). But in STB-LAB, of course, this can be handled well because STB-LAB has a syntax carried out in parallel between virtual and real, allowing these two activities to run properly.

In collaborative learning, activities between educators and students must be related to one another, where students and educators must jointly solve common problems to obtain results that are in accordance with theory (Jeong and Hmelo-Silver, 2016). The STB-LAB model is certainly able to facilitate collaborative learning well, shown from the implementation of blended laboratory activities between educators and students, which is getting very good results because STB-LAB, in its activities, requires educators to always provide feedback and related suggestions. Research will be carried out by students in blended laboratory activities. However, blended laboratory activities require a medium that can facilitate between virtual and real activities in real-time (Dangwal, 2017); this can be resolved by using the right technology because if a technology can be used properly, a problem can occur. Resolved, as in a blended laboratory, a technology is needed that can unite the virtual and real (Melis et al., 2019). The use of Gather Town is considered very appropriate in carrying out blended laboratory activities, where Gather Town can facilitate virtual and real activities on one server at the same time. Users who carry out virtual and real laboratory activities together carry out laboratory activities in the same room according to the design. That has been designed by educators. Gather Town plays an important role in the implementation of bled laboratory because all of Gather Town's features are deemed appropriate for the need to carry out blended laboratory, such as sharing screens or activating the camera together, and has its own discussion room according to the group without requiring a break-out room.

In terms of improving students' collaborative skills, based on tracking the results of statistical tests carried out, it shows that the STB-LAB model is able to improve students' collaborative skills with the effect obtained, namely the large effect on physics education major and biology education major. This acquisition was obtained because the disposition stage until communication requires educators to monitor and direct students in each activity. Students carry out the disposition stage to discuss a given problem based on the educator's design; from this disposition stage, students must collaborate well with their friends to narrow down a broad problem into a detailed one. Based on the narrative from previous researchers, which stated that giving a problem to be solved to students where students will consciously carry out discussions with their friends to understand the problem to be solved (Eyisi, 2016). In addition, group discussions to understand problems can hone students' collaborative skills because there is an interaction between friends in the group (Delamont, 2017).

The next stage is the argumentation stage, which in this argumentation stage does not really form the collaborative skills of students because the argumentation stage focuses on interactions between educators and students in this argumentation. Stage it focuses on forming collaborative learning, where students describe their arguments against a problem, which then the educator will provide enlightenment or provide input on what steps must be taken by these students in getting the answer with laboratory activities. This interaction can create good collaborative learning because educators act as facilitators for students in building their cognitive abilities (Hadwin, Järvelä and Miller, 2017). In addition, providing the best directions for students and educators in laboratory activities will minimize misconceptions that occur so that students will be very well-formed (Wismath and Orr, 2015).

In the verification stage and in the laboratory stage, interaction will be created between students in their groups, where students will conduct a review by conducting a literature study to deepen again regarding the steps of laboratory activities to be carried out, which, of course, requires further discussion in providing various opinions of these students. Sharing opinions in exploring knowledge, of course, will have the impact of good collaboration, where good collaboration is when students are able to express their opinions well and are able to accept other people's opinions well or reject them wisely so that all of these opinions will produce conclusions fast (Bower, Lee and Dalgarno, 2017). The verification activities carried out by students, resulting in a discussion period for verification of ten to twenty-five minutes for each group, show that students are able to collaborate well with their groups. The good in collaboration can also be determined based on the completion time of the discussion, where previous researchers explained that good collaboration is when you can streamline your time in discussions, but back in a quality perspective, sometimes fast collaboration does not always show good quality (Schneider and Pea, 2017). The quality of the discussion results will be proven by concrete evidence (Rozo et al., 2016). Real evidence of the results of the quality of the discussion is evidenced by the laboratory stage, where students will carry out experiments based on the results of discussions with their group mates.

The experimental results obtained by students will be communicated through the stages of communication. Based on the laboratory stages, students were seen to be very active in carrying out experiments in accordance with the division of tasks from the results of previous discussions; not a few of these students worked together with other friends to achieve their goals, for example, when using a traditional spectrometer they were divided into two observers, one leader to find the right color spectrum, and two people to record the results. However, from the division of tasks, it can be seen that students take turns as data is exchanged so that all students feel and know how to use tools, observe, and sort data. Of course, this is also known as a chain role, where the chain role in this laboratory activity is defined as exchanging resources to gain experience on an equal footing with others (Kirschner et al., 2018). This illustrates good collaboration so that students are able to understand the meaning of collaboration, which, of course, will increase the students' collaborative skills.

The obstacles that occur during blended learning using the STB-LAB model are interactions between students virtually and students in real terms. These obstacles focus on the internet connection, which is sometimes interrupted, thus hindering the course of activities. Internet connection is very important in smoothly running blended laboratory activities because internet connection is the most important component in smooth communication between students (Heflin, Shewmaker and Nguyen, 2017). Sometimes, miscommunication occurs between educators, virtual students, and real students, so the students' understanding is sometimes not conveyed properly. Of course, poor delivery due to an internet connection will hinder students' cognitive development and collaboration between friends, so good collaboration in a blended laboratory must be balanced with a good internet connection (Duţă and Martínez-Rivera, 2015).

The limitation of this research is that it is limited to the majors used, where the science education major must cover physics, chemistry, and biology education majors, or those that concentrate specifically on science education. Still, this study only uses physics education majors and biology education. In addition, this study was limited in terms of the number of subjects used because the Gathertown platform was limited to forty-five participants, and researchers did not have the extra budget to design this study on a larger scale.

CONCLUSION

Based on the results obtained from this study, there were several direct findings and unexpectedly, were direct findings for the first goal, namely the implementation of blended laboratory activities using STB-LAB with the help of Gather Town as a gamification tool for blended laboratory assessed using AABTLT with SAS obtained good implementation results so that the activities can run well. Then, for direct findings on the second goal, there was a difference in scores between the pretest and posttest for the experimental class in both the physics and biology education major, so this shows that STB-LAB with the help of Gather Town as a gamification tool for blended laboratory can improve collaborative skills. The magnitude of the influence can be known by showing an effect size for the physics education major in the experimental group, which got a score of 1.736 and 0.754 in the control group. In addition, the biology education major in the experimental group received a score of 1.522 and 0.541 in the control group. This shows that students' collaborative skills can be improved greatly by using STB-LAB. Indirectly, this study obtained results in the form of several obstacles that occurred in blended laboratory activities using the Gather Town-assisted STB-LAB model as a gamification tool, namely paying more attention to collaborative skills assessment, where collaborative assessment must be designed in detail so that all collaborative aspects can be assessed, besides that, the major used must be readjusted, because STB-LAB focuses on science blended laboratory activities, so it must require a complete major from science, or pure science itself.

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