RESEARCH ARTICLE

Does student's critical thinking and collaboration skills can empower through investigation and thinking learning strategy?

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Abstract: The low critical thinking skills and collaboration skills of students in biology learning are caused by the dominance of conventional learning, so they require alternative learning strategies. This study aims to determine the effect of GITTW learning strategy on student critical thinking and collaboration skills. The research design used was quasi-experiment with a pre-test and post-test control group design. The class X of Science-2 and of Science-3 SMA Negeri 01 Paciran became sample (N=72), with details; the control class and treatment class consisting of 36 students. Data collection critical thinking skills using easy test before and after treatment with Facione rubric developed and data collaborative skills using observation sheet assessment rubric developed by Suharti. Data were analyzed descriptively and statistically through normality test, Wilcoxon test with =0.05, and N-gain test. The results showed that the GITTW learning strategy had an effective effect, and can be applied by the teacher as an alternative learning strategy.

Keywords: Collaboration skills; critical thinking skills; GITTW

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Introduction

The 21st-century skills are critical to student development. Demands that must be faced in the 21st century namely 4C skills; creative thinking, critical thinking, problem-solving, communication, and collaboration (Thornhill-Miller et al., 2023). Students need to be prepared to master these skills (Triana et al., 2020). 21st century learning aims for students to master critical thinking skills. Learning emphasizes more on students being able to formulate problems besides being able to solve problems, it also encourages students to cooperate and collaborate in solving problems. Optimize 21st century skills Wijaya et al., (2016) state, students need to have critical thinking abilities. The importance of critical thinking skills is needed in the learning process of solving problems and making decisions among students, because it hones the skills of interpretation, analysis, evaluation, synthesis, explanation, inference, and self-regulation (Wale & Bishaw, 2020). The same findings as Hapsari et al., (2012) revealed several findings from observations of biology learning, namely that learning is still dominated by lectures from teachers and students listen more, active involvement of students is still lacking. This makes students curiosity very less so that their critical thinking skills also tend to be low. Critical thinking is a reflective thinking ability that focuses on patterns of decision making about what must be believed, must be done and can be accounted for (Ennis, 2011). Mahanal's opinion states that improving critical thinking skills in biology learning is very important (Mahanal et al., 2019). Therefore, critical thinking skills must be trained early in the learning process, so that students can be trained in making a decision on a problem (Ahmatika, 2017). Through empowering critical thinking skills, it allows students to explore their potential to see problems, formulate problems and answer problems (Fitriani et al., 2020). The role of the teacher is very important in learning, therefore teachers are required to be able to choose and use various strategies, methods, and varied learning media (Handayani et al., 2018). Thus, it is expected that learning is not boring, which has an effect on the development of students' thinking skills.

A number of studies have shown that students' critical thinking skills and scientific attitudes can be empowered through contextual, student centered learning (SCL) and constructive learning approaches (Qarareh, 2016). Hidayah et al., (2019) research results, revealed that the implementation of various learning models can affect students' thinking skills. Research by Bustami et al., (2019) shows that there is a significant effect of the Think Talk Write (TTW) learning model on critical thinking skills than conventional learning. Zubaidah et al., (2018), the results of his research show that the implementation of the REMAP Group Investigation (GI) learning model can improve critical thinking skills and reading interest. Research by Silva et al.,(2023), states that the GI model influences students' critical thinking skills and creative thinking skills. Jariah & Aminatun (2022), research findings thatthe socio-scientific approach to issues with the GI learning model proved to be more effective in improving students' critical thinking skills than conventional learning models. The research conducted is different from other studies, in this study using investigative and thinking learning strategies, namely the GITTW strategy where the TTW syntax is integrated into the GI syntax. The two syntaxes in the GITTW strategy complement and strengthen each other (Listiana et al., 2020).Each stage of the GITTW strategy can train students to improve critical thinking skills and collaboration.

Apart from critical thinking skills, collaboration skills are also 21st century skills that need to be empowered. Collaboration in learning allows students to exchange ideas, information and knowledge with their peers. In addition, collaboration can increase students' self-confidence, so that collaboration can optimize students' understanding of the material (Rosita & Leonard, 2015). The ability to coordinate and collaborate among students who have skills in planning, executing and evaluating projects enable them to achieve common goals (Krisnawati & Suharti, 2020; Suharti et al., 2020). In collaborative activities, low-quality coordination often occurs between group members such as when solving problems, there are still group members who do not pay attention to the opinions of others, interrupt other people's conversations, and do not respect the opinions of others (Johnson, 2014). In addition, group members reject alternative suggestions without justification, so inappropriate behavior can hinder the functioning of groups and individuals who are learning(Le et al., 2018).

The results of the pre-observation at State Senior High School Paciran showed that there were still students who had not reached the KKM score of less than 65 and were categorized as sufficient. Another thing, students very lacking in giving arguments, ask questions, and draw conclusions. This is because conventional learning still dominates, students only listen, take notes, and work on questions assigned by the teacher. Students memorize more without understanding concepts well, and there are no activities that can encourage students to think critically and cause biology students' critical thinking skills to be low. The pre-observation results also show that teacher-student interaction, student-student interaction is rare. Discussions in groups are not used to being carried out, students learn more individually. So that the process of interaction, cooperation and collaboration in solving problems is very low.

As solutions to these problems, it is necessary to train and empower critical thinking skills and student collaboration with investigative learning strategies and innovative thinking. One strategy that is considered appropriate to improve critical thinking skills and collaboration is the GITTW (Group Investigation and Think Talk Write) strategy. Listiana et al,. (2016a), whose research results show that the GITTW strategy which is integrated with GI and TTW complements each other and optimizes the potential of both in empowering students' critical thinking skills. GI and TTW syntax in GITTW have the same goal, namely to develop learning that trains critical thinking and reasoning skills, so that students are skilled in arguing, solving problems and providing conclusions. Bustami & Corebima (2017) revealed that critical thinking can be used as a basis for analyzing arguments and insight into every meaning and interpretation to develop logical reasoning. Therefore, it is necessary to conduct research to empower critical thinking skills and collaboration through the GITTW learning strategy. This research is expected to contribute to teachers by using the GITTW learning strategy as an alternative model or innovative learning strategy.

Method

Research Design

This research was conducted at State Senior High School 1 Paciran Lamongan. This type of research is Quasi Experiment by using Non-equivalent Control Group Design (Sugiyono, 2017). The study design was a non-equivalent pre/post-test control group design, with tests conducted at the beginning (pretest) and the end (post-test) of learning in the control and experimental groups, showed the Table 1.

Table 1. Research design

Group	Pretest	Treatment	Post-test
Experiment class (GITTW)	O1	X1	O2
Control class (conventional method)	O3	X2	O4

Context and Participants

The population of this study was all students of class X State Senior High School grade 1 Paciran with a total of 72 students in class X science-2 and X science-3. each class consisting of 36 students. The sampling technique in this study uses probability sampling of the simple random sampling type (Sugiyono, 2017). Sampling is done randomly. The results of the draw selected two classes, namely class X MIPA-2 as the experimental class using GITTW and class X MIPA-3 as the control class using conventional methods. The purpose of this study was to find differences in the effects of GITTW learning strategies on improving critical thinking skills and collaboration skills before and after being given treatment. The independent variable was the implementation of the GITTW learning strategy, while the dependent variable was students' critical thinking and collaboration skills. The research instruments and learning tools used in the treatment were learning implementation plans, student worksheets, critical thinking skills test sheets, collaboration skills observation sheets. All instruments have been validated by three experts. The test questions after being validated are then subjected to limited trials, in order to obtain the value of the validity and reliability of the test.

Data Sources

The data collection of techniques through tests (pretest-posttest) and observation. Students' critical thinking skills are measured using an essay test consisting of 5 questions. Essay tests were developed by researchers with a rubric of critical thinking skills developed by (Facione et al., 2011). The scoring criteria for the critical thinking skills test used in this study refer to 6 critical indicators namely: interpretation, analysis, evaluation, inference, explanation, self-regulation (Facione, 2020). Essay tests are given before the learning process (Pretest) and after the learning process (Posttest). Student collaboration skills and the implementation of learning are measured using observation sheets. The collaboration observation sheet uses the collaboration skills assessment rubric developed by (Suharti, 2019).

Data Analyses

The data critical thinking and collaboration skills were analyzed descriptively and statistically through the normality test, because the data is not normally distributed, the Wilcoxon test is carried out with α=0.05, and the N-gain test was used to see how effective the increase was. The categories for interpreting the effectiveness of N-Gain are <40 ineffective, 40-55 less effective, 56-75 effective enough, >75 effective (Hake, 1999).

Results and Discussion

The research question in general is Does Student's Critical Thinking and Collaboration Skills can Empower through Investigation and Thinking learning Strategy? and the specific question is how does the effect of GITTW learning strategy on students' critical thinking skills and collaboration?
The following will explain the results of the study with two sub-themes, which are; a) The Effectiveness of Strategy GITTW on Critical Thinking Skills; and b) The Effectiveness of Strategy GITTW on Collaboration Skills

The Effectiveness of the Strategy GITTW on Critical Thinking Skills

This study used instruments to collect data, namely learning tools consisting lesson plan, students' worksheets, test sheets, observation sheets for collaboration skills. The instrument has been validated with 3 validators. The results of validating learning tools using the GITTW strategy (Group Investigation integrated with Think Talk Write) are shown in Table 2.

Table 2. The results of the validation of learning tools using the GITTW strategy

The value of the validation results of learning devices	Validator			Average
	1	2	3	
Lesson plan	3.86	3.24	3.38	3.49
Worksheet	3.89	3.11	3.34	3.45
Critical thinking test sheets	3.65	2.89	3.59	3.38
Collaboration observation sheet	3.85	2.92	3.15	3.31

The results of validating learning tools using the GITTW strategy from three validators obtained an average lesson plan of 3.49, an average worksheet of 3.45, an average of 3.38 critical thinking test sheet scores, and an average of collaborative observation sheets of 3.31. As for the results of the validity and reliability tests, the difficulty index and the distinguishing power of the critical thinking skills test are shown

in Table 3.

Table 3. The results of the validity and reliability tests, the difficulty index and the differentiating power of the critical thinking skills test

Question number	Validity	Reliability	Category	Difficulty level	Category	Different power	Category
1	0.70		Valid	0.31	Currently	0.33	Enough
2	0.67		Valid	0.25	Hard	0.42	Good
3	0.48	0.843	Valid	0.35	Currently	0.27	Enough
4	0.70		Valid	0.31	Currently	0.33	Enough
5	0.64		Valid	0.29	Hard	0.45	Good

The results of the validity test of the critical thinking skills test questions number 1 to 5 are in the valid category, which means they are feasible to use. then the difficulty level of questions number 1,3.4 is in the moderate category, question number 2.5 is in the difficult category. as for the discriminating power on questions number 1,3.4 in the sufficient category, and question number 2.5 in the good category.
A summary of analysis results description of indicators of critical thinking skills, in experiment and control class, is shown in Table 4.

Table 4. The summary of analysis results description of indicators of critical thinking skills

Indicator	Experiment Class				Control Class			
	Pre-test	Category	Post-test	Category	Pre-test	Category	Post-test	Category
Interpretation	53	Very Low	93	Very High	48	Very Low	77	Moderate
Analysis	39	Very Low	90	Very High	40	Very Low	75	Moderate
Evaluation	31	Very Low	89	High	27	Very Low	75	Moderate
Inference	26	Very Low	94	Very High	27	Very Low	75	Moderate
Explanation	49	Very Low	97	Very High	44	Very Low	83	High
Self-Regulation	28	Very Low	95	Very High	26	Very Low	78	Moderate
Total	226		558		212		463	
Average	37.6		93		35.33		77.16	

Based on the results of the analysis of the description of the indicators of students' critical thinking skills the experiment on the pretest for each indicator is categorized very low, while the post-test is categorized into the very high category for interpretation, analysis, inference, explanation, self-regulation and high category for evaluation. The results of the descriptive analysis of the indicators of students' critical thinking skills of the control class in the pretest for each indicator were categorized very low, while in the post-test it was categorized into the high category for explanation, and moderate category for interpretation, analysis, evaluation, inference, self-regulation.
The normality test of students' critical thinking skills in the experimental and control classes is not normally distributed. The next stage used to determine the effect of the GITTW strategy on the critical thinking of students in the experimental and control groups was to use the Wilcoxon test with a significance level of 0.05, the results are shown in Table 5.

Table 5. Wilcoxon test results of critical thinking skills

Test Statistics[a]	
	Control Class – Experiment Class
Z	-5.185[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks.

The Wilcoxon test results obtained a significance value of <0.05 with a total value of 0.000. indicating this study proved the effect of GITTW learning strategy (Group investigation combined with Think talk write) can improve students' critical thinking skills at SMA Negeri 1 Paciran. To determine the effective of GITTW strategy increase is based on the average N-Gain result. The results are shown in Table 6.

Table 6. N-gain test of critical thinking skills

Descriptives

	Class			Statistic	Std. Error
N-Gain	Experiment	Mean		89.3176	1.25743
		95% Confidence Interval for Mean	Lower Bound	86.7649	
			Upper Bound	91.8703	
		5% Trimmed Mean		89.5403	
		Median		90.3261	
		Variance		56.920	
		Std. Deviation		7.54457	
		Minimum		74.63	
		Maximum		100.00	
		Range		25.37	
		Interquartile Range		9.73	
		Skewness		-.332	.393
		Kurtosis		-.635	.768
	Control	Mean		67.4960	1.26025
		95% Confidence Interval for Mean	Lower Bound	64.9376	
			Upper Bound	70.0544	
		5% Trimmed Mean		67.7574	
		Median		68.6567	
		Variance		57.176	
		Std. Deviation		7.56149	
		Minimum		46.77	
		Maximum		80.65	
		Range		33.87	
		Interquartile Range		8.79	
		Skewness		-.658	.393
		Kurtosis		.585	.768

Based on the N-Gain test, in the experimental class an average value of 89,32% is obtained and the control class obtains an average value of 67,76%. This shows that the increase in students' critical thinking skills in the experimental class after using GITTW learning strategy was in the effective category, and in the control class after being given various learning methods it was in the effective enough category.

The results of this study indicate that the GITTW implementation strategy can improve students' critical thinking skills and collaboration. The GITTW strategy is a cooperative learning model, with its syntax training students to think about solving problems through investigating a topic or issue (Listiana et al., 2016b). In stage (1) the activity of analyzing and identifying topics through thinking and discussing to determine problems and then planning problem solving, can encourage students to think critically. In accordance with the opinion of Fitriani et al., (2020), student activities in viewing and examining problems, formulating problems and solving problems can explore students' potential to practice critical thinking. In stage (2) the task planning activity, all students are involved in thinking, opinion in dividing tasks to solve problems. This stage is very supportive of collaboration and thinking in the process of producing joint decisions on the division of tasks. Supported by Ma et al., stated that the decision-making process is a rational effort of the administrator to achieve the goals that have been set in the early part of the planning function (Mueller et al., 2020). Stage (3) investigative activities, each member in the group conducts an investigation to find and collect data (write) to discuss the problem. Stage (4) analysis and synthesis activities (think, talk), where students develop their thoughts and ideas in more detail. Stage (5) making presentations (think, talk, write), students actively interact through questions and answers both with friends and with the teacher. Finally, stage (6) evaluates (think, write) which focuses on achieving understanding. Overall, at all stages of GITTW encourages and trains critical thinking skills. This is reinforced by several opinions, critical thinking includes analyzing and interpreting data in scientific activities (Mueller et al., 2020; Maknun, 2020). Students in critical thinking use reasonable thinking to decide what to do according to their intellectual abilities (Paul & Elder, 2019).

The critical thinking skills are facilitated by GITTW strategy which is contained in 6 stages. (1) identifying topics, grouping and determining subtopics (Think and write), at this stage, students are trained to identify and analyze problem topics. This trains students to think critically. Communicating ideas, developing existing ideas, (2) plan assignments that will be studied and compile the results of the discussion (Think, talk, and write), at this stage enables students to develop critical thinking skills related to self-regulatory indicators and to organize and plan to complete group tasks, (3) investigation, observe, collect, and write information (Think and write), at this stage students can carry out investigations regarding a linkage of a

statement that develops critical thinking skills and indicators of analysis, Critical thinking is also interpreted as an individual's expertise in obtaining information and solving problems from the process of extracting information about the problems encountered (Christina & Kristin, 2016).

The stage (4) analyze, discuss, and synthesize information (Think, talk, and write), at this stage students can observe and explain an event based on a detailed concept that develops critical thinking skills on analysis and explanation indicators, (5) presenting the final result and conducting class discussions (Think and talk), at this stage students and their groups can understand and express the final results clearly and can explain concepts in detail that develop critical thinking skills on interpretation and explanation indicators, (6) evaluation, reflection, and conclude (Think, talk, and write), at this stage it trains students to develop critical thinking skills on indicators of inference and evaluation so that they can draw conclusions logically based on data and assess the truth of the information obtained (Listiana *et al.*, 2016a).

Biology material contains many abstract concepts so that learning is always associated with everyday life. This abstract material requires deep thought to avoid any misconceptions. Thinking deeply about something is to think critically. According to Surya et al., (2014) critical thinking in understanding the material aims to enable students to make appropriate conclusions based on the understanding that has been confirmed by the teacher. Based on the results of the posttest, there are indicators of critical thinking related to biology material. The critical thinking indicators are interpretation, analysis, evaluation, inference, explanation and self-regulation (Facione, 2020). All indicators of critical thinking can be empowered through the GITTW learning strategy training that helps students gradually develop their thinking skills.

The GITTW strategy through its syntax can empower students' critical thinking skills. All indicators of critical thinking, interpretation, analysis, evaluation, inference, explanation, and self-regulation can be well trained through GITTW syntax. It can be concluded that the GITTW strategy can improve students' critical thinking.

The Effectiveness of the Strategy GITTW on Collaboration Skills

A summary of the results of analysis the proportion of collaboration skills, in experiment and control class, is shown in Table 7.

Table 7. The Summary of the results of analysis the proportion of collaboration skills

Indicator	Experiment Class		Control Class	
	Category			
	Meeting 1	Meeting 2	Meeting 1	Meeting 2
Contribution	Incomplete	Complete	Incomplete	Incomplete
Time management	Incomplete	Complete	Incomplete	Incomplete
Problem solving	Incomplete	Complete	Incomplete	Incomplete
Working with others	Incomplete	Complete	Incomplete	Incomplete
Research techniques	Incomplete	Complete	Incomplete	Incomplete
Quality of work	Incomplete	Complete	Incomplete	Incomplete
Focus on the task	Incomplete	Complete	Incomplete	Incomplete
Preparedness	Incomplete	Complete	Incomplete	Incomplete
Monitoring group effectivity	Incomplete	Complete	Incomplete	Incomplete

The analysis of the proportion of collaboration skills in the experimental class in the first meeting, each indicator gets an incomplete category and the second meeting, each indicator gets a complete category. While the analysis of the proportion of completeness indicators of control class collaboration skills at the first and second meetings for each indicator received an incomplete category. To find out the effect of GITTW strategy on students' collaboration skills in the experimental and control groups, the Wilcoxon test was carried out, the results are shown in Table 8.

Table 8. Wilcoxon test results of collaboration skills

Test Statistics[a]	
	Meetings 1 and 2 Control Class Meetings 1 and 2 Experiment Class
Z	-5.233[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks.

The Wilcoxon test results obtained a significance value of <0.05 with a total value of 0.000. indicating this study proves the effect of GITTW learning strategy (Group investigation combined with Think talk write) can improve collaboration skills of students at SMA Negeri 1 Paciran. The effective the of GITTW strategy increase is based on the average N-Gain result. The results are shown in Table 9.

Table 9. N-gain test of collaboration skills

Descriptives

	Class			Statistic	Std. Error
N-gain	Experiment	Mean		71.0000	3.02896
		95% Confidence Interval for Mean	Lower Bound	64.8509	
			Upper Bound	77.1491	
		5% Trimmed Mean		70.8333	
		Median		72.5000	
		Variance		330.286	
		Std. Deviation		18.17376	
		Minimum		45.00	
		Maximum		100.00	
		Range		55.00	
		Interquartile Range		32.25	
		Skewness		.099	.393
		Kurtosis		-1.334	.768
	Control	Mean		6.8611	.72282
		95% Confidence Interval for Mean	Lower Bound	5.3937	
			Upper Bound	8.3285	
		5% Trimmed Mean		6.3951	
		Median		4.0000	
		Variance		18.809	
		Std. Deviation		4.33690	
		Minimum		4.00	
		Maximum		23.00	
		Range		19.00	
		Interquartile Range		7.00	
		Skewness		1.773	.393
		Kurtosis		3.906	.768

Based on the N-Gain test, in the experimental class obtained an average of 71% and the control class obtained an average of 6,86%. This shows that the increase in students' collaboration skills in the experimental class after using GITTW learning strategy was in the quite effective category, while in the control class after being given conventional methods it was in the ineffective category.
The results of the analysis proportion of collaboration skills obtained the averages, value contained in the graph of increasing collaboration skills in Figure 1.

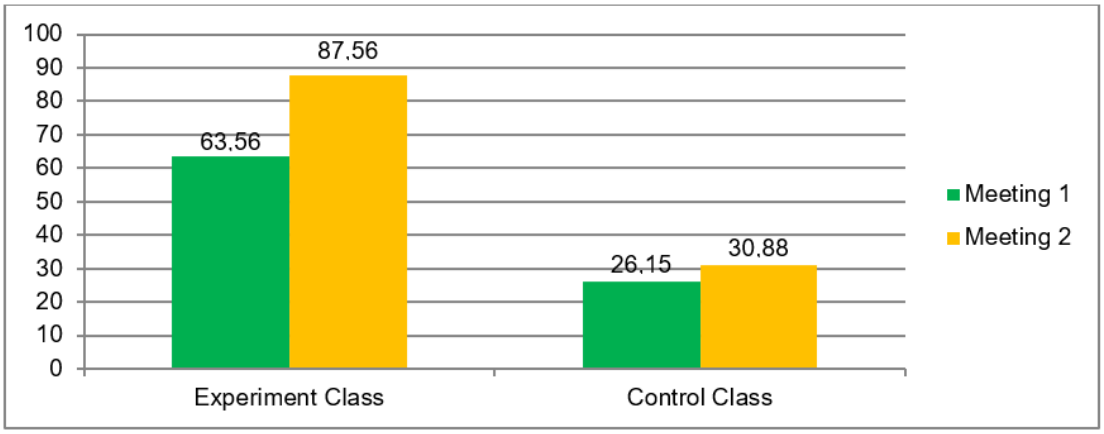

Figure 1. Graph of increasing student collaboration skills

Based on the graph of increasing student collaboration skills, the average score or collaboration skills of the experimental class was 63.56 in the first meeting and 87.56 in the second meeting. Meanwhile, the

average of collaboration skills in the control class was 26.15 in the first meeting and 30.88 in the second meeting. The findings of the results of increasing collaboration skills in the experimental class reached 87.56. And based on the rubric or criteria for the value of collaboration skills students are said to be complete if they achieve a minimum collaboration mastery proportion score of 75, so that the increase is not up to 100% (Suharti, 2019).

The results of the study indicated that the implementation of the GITTW strategy had an effect on students' collaboration skills. Learning using the GITTW Strategy is significantly different from conventional learning, because conventional learning students learn individually, learning is only transferring knowledge, students tend to be inactive and not facilitated to develop collaboration skills. According to the opinion of Hasan & Pardjono (2019), learning that emphasizes the ability to remember (C1) and understand (C2) is difficult for students to develop their collaboration skills. Collaborative ability is a process of working together to generate ideas and solve scientific problems together toward a common vision (Yu et al., 2022). The GITTW strategy includes a cooperative learning model, students' study in groups and discuss solving problems or producing a work or scientific product. All students are actively involved in the learning process through activities at the GITTW syntax stages. The GITTW learning strategy, which is packaged in the form of a cooperative learning model, is an innovative strategy that integrates students' thinking, writing and communication skills to investigate problems (Listiana et al., 2020).

The develop of collaboration skills were facilitated by GITTW strategy found in syntax, (1) identifying topics, grouping and determining subtopics (Think and write), at this stage every pupil conveys thoughts and collaborates with one another to identify topics and determine subtopics, at this stage students are directed by the teacher. (2) plan assignments that will be studied and compile the results of the discussion (think, talk, and write), at this stage students and their groups can discuss time management at this stage and finish on time to hear their friends' opinions. At this stage students have a little difficulty reaching an agreement on the division of tasks, but the teacher guides them, (3) carry out investigations, observations, collect and write information (think and write), at this stage, students come up with ideas, seek out theoretical sources, and focus on divided tasks. In the student investigation process there were a few difficulties due to the availability of the internet which was not very supportive for gathering information and data. (4) analyze, discuss, and synthesize information (Think, talk, and write), at this stage, students are learning actively, discuss in groups, and do their best. Analysis activities require more in-depth information, some students experience difficulties because they are not used to discussing solving problems in groups, especially in the control class. (5) presenting the final result and conducting class discussions, at this stage, students will work with their groups to bring the material needed and show the final results, all groups collaborate to display their work and provide explanations and arguments to other groups, (6) evaluation, reflection, and concluding, this stage trains students to assess their group's work, monitor completed work, and provide feedback to improve learning outcomes. (Listiana et al., 2016a). At each stage of the GITTW syntax shows how students' in their groups collaborate to discuss and solve problems together. Each student in the group has duties and responsibilities in completing assignments and they work together to achieve the same goal, namely obtaining the best results.

During the learning process, there is interaction between students and students, and students and teachers. Interaction occurs Through learning activities with the discussion method, there is an expectation that students can work together, especially on indicators providing contribution, time management, problem solving, working with others, research techniques, quality of work, focus on the task, preparedness, and monitoring group effectiveness. According to Herro's opinion, students' collaboration abilities are seen during discussion activities (Herro et al., 2017). At each stage of the GITTW syntax shows how students' in their groups collaborate to discuss and solve problems together. Each student in the group has duties and responsibilities in completing assignments and they work together to achieve the same goal, namely obtaining the best results. Anugerahwati (2019) collaboration skills show how students use different personalities, talents, and knowledge to work together and create something new. Collaboration skills in a group can enable each member of the group to solve problems together in achieving certain goals. According to Graesser et al., (2018), collaboration abilities are important for achieving the best results when solving complex problems. The research still has limitations therefore it is hoped that in future research it can be studied in more depth. The great potential of this strategy in empowering students' thinking skills needs to be continuously applied at all levels of education. Further research can be done by adding an electronic textbook design based on the GITTW strategy.

Conclusion

Based on the results and discussion of this study, it can be concluded GITTW strategy (Group Investigations integrated with Think Talk Write), students' critical thinking skills improved with effective category and in the control class without the application of the GITTW strategy with effective enough

category. Students' collaboration skills increase after applying the GITTW strategy with a quite effective category, and in the control class without applying the GITTW strategy with an ineffective category. Furthermore, this learning strategy can be applied to other subjects at the senior high school or junior high school level, it is hoped will be used by the teacher as an alternative innovation in learning that can be done face-to-face or online.

The results of this study indicate a significant effect of the GITTW strategy (group investigation integrated Think Talk Write) in improving critical thinking and collaboration skills. Therefore, teachers must use the GITTW learning strategy as an alternative to innovative learning strategies that can train and empower students' critical thinking skills. Likewise, collaboration skills, teachers must always teach students in groups so that students discuss to work on assignments to solve problems. The use of this strategy can be done face-to-face or online, but online will certainly experience problems. During learning the teacher always accustoms students to sitting in their groups so that students can interact with members in their groups so that collaboration occurs to achieve common goals. The main task of the teacher before teaching is of course to design lesson plans or teaching modules dan worksheet students, so design the lesson plan by always using learning strategies or models that involve active students, which require students to think. This GITTW strategy with its six syntaxes is able to empower critical thinking and collaboration skills.

Research on this new strategy, namely the GITTW learning strategy, still has limitations, therefore it is hoped that in future research it can be studied in more depth. The great potential of this strategy in empowering students' thinking skills needs to be continuously applied at all levels of education. This research was conducted on high school students, while it has not been carried out on junior high school and elementary school students. For application in tertiary institutions, it has only been carried out in the biology education study program in the subject of Anatomy and Function of the Human Body. This limitation needs to be continued by the next researcher, namely by conducting research using the GITTW strategy at different levels of education and in different study programs in tertiary institutions. Further research can be done by adding an electronic textbook design based on the GITTW strategy.

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contributions

L Listiana: Data curation; Writing original draft, writing, review, and editing. **N Mutiaraloka:** Writing an original draft; Formal analysis. **Y Gayatri:** Writing, review, and editing.

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