IMPROVING CRITICAL THINKING ABILITY AND BIOLOGY LEARNING OUTCOMES IN SENIOR HIGH SCHOOL WITH THE SCIENCE TECHNOLOGY AND SOCIETY APPROACH WITH THE ASSISTANCE OF E-LKPD

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Abstract. The aim of this research is to explain the application of the STS (Science, Technology, and Society) approach with the assistance of E-LKPD to improve critical thinking skills and Biology learning outcomes for class XI PMIIA5 students on immune system material at SMA Negeri 2 Yogyakarta in the 2020/2021 academic year. The type of research carried out is Classroom Action Research (CAR) which follows the model of Stephen Kemmis and Robin McTaggart, through the stages of planning, action, observation, and reflection (reflecting). The approach of Science, Technology, and Society Assisted by E-LKPD is carried out by following stages 1) invitation; 2) exploration (exploration); 3) explanations and solutions (proposing explanations and solutions); and 4) taking action. The results of the action showed that all indicators of critical thinking skills increased in cycle 2. The average indicator of critical thinking skills increased by 0.14 points from 2.89 to 3.03 in cycle 2. The indicator of rejecting incorrect and irrelevant information increased from 3.14 to 3.25 in cycle 2. The indicator of detecting and correcting conceptual errors increased from 2.77 to 2.83 in cycle 2. The indicator of seeking new solutions increased from 2.64 to 2.96 in cycle 2. While the indicator made a decision or conclusion after collecting the facts increased from 3.01 to 3.08 in cycle 2. Learning outcomes data showed that the average value of student evaluation increased by 12.37 points from 62.8 to 75.17 in cycle 2. The percentage of class completeness increased by 44 points from 33% to 77% in cycle 2. While the percentage of class incompleteness decreased by 44 points from 67% to 23% in cycle 2. In general, the average value of all poster assessment indicators increased by 1.23 points from 94.7 7 becomes 96.00 in cycle 2.

Keywords: Science Technology and Society, Biology Education, Critical Thinking

PENDAHULUAN

Disruption in the education sector due to the COVID-19 pandemic has forced students to deal with the digital ecosystem. Students must be able to adapt to technology-based learning activities, which support the development of 21'st century skills, namely communication, collaboration, creativity, and critical thinking (Afriana, et al., 2016). Researchers argue that the low critical thinking skills of students correlate with learning behavior and behavior in living daily life, especially during the COVID-19 pandemic. The results of the researcher's evaluation of the online learning activities of students XI PMIIA5 at SMA Negeri 2 Yogyakarta in the previous semester, showed that the activeness of students was still lacking. As many as 12.6% or 5 out of 36 students were recorded as not actively participating in Biology online classes. Some students have problems with technology devices (mobile phones and laptop), internet connection is less stable, less

motivated because they study independently, and sometimes they are late to join synchronous learning sessions because they fall asleep. These obstacles ultimately cause online learning, especially in Biology subjects, to be less effective. In the opinion of the researchers, this behavior shows that students lack moral responsibility for the knowledge they have learned. Students seem less concerned with the validity of the knowledge gained and less critical of the development of the surrounding situation related to the knowledge that is being built.

Regarding Biology learning on the material of the immune system, researchers consider that it is very important and relevant to build critical thinking skills to improve learning outcomes and student behavior, especially in the COVID-19 pandemic situation. Having critical thinking skills does not necessarily guarantee that students will become responsible people, at least these skills can prevent students from making wrong, immoral, and hasty decisions (Ermavianti & Sulistyorini, 2020). Robert Ennis defines critical thinking as the ability to think reflectively that makes sense and focuses on deciding what to do (Cutcliffe, and Mitcham, 2012). According to Sutisyana, students' critical thinking skills can be built and developed through the process of observing, comparing, classifying, hypothesizing, collecting data, interpreting, concluding, solving problems, and making decisions (Dass, 1999). According to Giambattista statement, a person can be categorized as having understood knowledge when he has experienced the event himself, his cognitive structure able to accept and construct it in his mind about elements that build knowledge (Fisher, 2011).

Edward Glaser describes 12 indicators that underlie critical thinking skills, including 1) recognizing problems, 2) finding ways or solutions that can be applied to the problem, 3) collecting and compiling related information, 4) recognizing assumptions and values, 5) understand and use language appropriately and clearly, 6) interpret data, 7) assess evidence and evaluate statements, 8) recognize logical relationships, 9) draw conclusions and generalizations, 10) test generalizations and conclusions obtained, 11) reconstruct belief patterns based on experience, and 12) provide an accurate assessment of events in everyday life (Susilo & Sudrajat, 2020). Referring to the characteristics and indicators of critical thinking that have been described, the researcher takes 4 critical thinking indicators that will be improved in this study, namely 1) rejecting incorrect and irrelevant information, 2) detecting and correcting conceptual errors, 3) finding new solutions, and 4) make a decision or conclusion after gathering facts.

To overcome obstacles in learning Biology online, especially in class XI PMIIA5, researchers designed Biology learning activities on immune system material with the STS (Science Technology and Society) approach assisted by E-LKPD. E-LKPD (Electronic-Student Worksheet) is student worksheet which is packaged in softcopy. E-LKPD (student worksheet) is a guide used by students to conduct investigations or develop abilities. E-LKPD contains a set of activities that must be carried out by students, to maximize their abilities according to predetermined indicators. E-LKPD which is used in this study was created by using the Book Creator application, a simple application that ussually use to create a book electronically. Even though it is in the form of a soft file, the function of the E-LKPD remains the same, namely as a guide for students, so that learning becomes more focused, guided, directed, and keep places the teacher in the position of facilitating students in building new knowledge concepts.

Akcay and Yager stated that the main character of learning with the STS (Science, Technology, and Society) approach is to raise social problems in the real world at the beginning of learning activities, which are relevant to student personal lives. According to Kumar and Chubin (2000), the STS approach is identical to learning that raises environmental issues, which aims to help students understand the relevance of science to everyday life, thereby stimulating students to be interested in learning more science. The

problems that arise in learning Biology on the subject of the immune system are the adaptation of 5M's new habits, namely wearing masks, washing hands, maintaining distance, staying away from crowds, and reducing mobility. After that, students are invited to understand the concept of the formation of the immune system through the mechanism of vaccination

The STS approach is closely related to the assignment of tasks and projects (Kumar & Chubin, 2000). The most basic difference between a task and a project lies in the timeframe for completion and the parameters of the work. According to John Ziman, STS learning is learning that uses technology as a liaison between science and society (Petchtone & Sumalee, 2014). Chubin and Chu state that the important value of studying science and technology in social phenomena is that students will learn about themselves when conducting investigations into the world and its contents (Kumar & Chubin 2000). The stages of implementing learning with the STS approach are divided into 4 phases, namely 1) invitation; 2) exploration; 3) proposing explanations and solutions; and 4) taking action (Sani, 2020). Invitation is a stage of stimulating students to remember by presenting issues in society through various media, then students formulate problems and hypotheses.

Exploration is the stage of finding answers or testing hypotheses, by searching for data from various sources of information. Explanation and solution are stages for communicating ideas obtained from information analysis, compiling explanations, discussing, and determining solutions, teachers guide students to integrate the concepts they produce with concepts from experts. The action is the stage for making decisions by considering mastery of scientific concepts and skills, sharing information and ideas, and asking new questions.

The characteristics of STS according to R.E. Yager are begins with observing issues related to science and technology, involve students actively in finding information to solve problems, identifying solutions, using information as evidence to make decisions, allows learning to take place in the classroom and outside of school, emphasize process skills to solve problems, provide opportunities to gain experience related to the problems that have been identified (Santoso et al., 2013)

Through this classroom action research, researchers are trying to improve students' critical thinking skills and Biology learning outcomes. In addition, researchers try to provide education regarding the adaptation of 5M's new habits in the face of the COVID-19 pandemic, as well as the importance of vaccination to break the chain of spread. The formulation of the problem in this study is 1) How is the application of the STS approach assisted by E-LKPD to improve critical thinking skills and learning outcomes of Biology material on the immune system in class XI science students at SMA Negeri 2 Yogyakarta? 2) Can the application of the STS approach with the assistance of E-LKPD improve the critical thinking skills of students in class XI science at SMA Negeri 2 Yogyakarta? 3) Can the application of the STS approach with the help of E-LKPD improve the learning outcomes of the material on the immune system of class XI science students at SMA Negeri 2 Yogyakarta?

The objectives of this classroom action research are 1) To describe the application of the STS approach with the assistance of E-LKPD to improve critical thinking skills and learning outcomes of biology material on the immune system in class XI science students at SMA Negeri 2 Yogyakarta, 2) Testing the application of the STS approach assisted by E-LKPD to improve critical thinking skills of students in class XI Science at SMA Negeri 2 Yogyakarta, 3) Testing the application of the STS approach assisted by E-LKPD to improve learning outcomes of the material on the immune system of class XI science students at SMA Negeri 2 Yogyakarta.

This classroom action research is expected to provide benefits for students, teachers, and schools. For students, it is hoped that they will experience an increase in critical

thinking skills and learning outcomes, understand the scientific reasons why they should apply 5M, and understand the importance of vaccination. For teachers, it can provide experience and references for implementing students-centered learning, to improve critical thinking skills and learning outcomes. For schools, the 5M new habit adaptation campaign can be taken into consideration in making policies regarding the establishment of health protocols during the COVID-19 emergency response period.

METHOD

Research approach

The type of research carried out is classroom action research (CAR) by following the model of Stephen Kemmis and Robin McTaggart. According to Marwah et al (2017), the CAR stages of the Kemmis-McTaggart model include planning, action, observation, and reflection. Efforts to solve problems in CAR are carried out using the STS approach assisted by E-LKPD through 2 cycles of action as follows: 1) Cycle 1 is carried out in 2 meetings, by carrying out Biology learning material for the scientific study of the 5M health protocol movement, 2) Cycle 2 is carried out in 2 meetings, by carrying out Biology lessons on vaccination movement materials during the COVID-19 pandemic.

Population and sample

The population in this study were all students of class XI MIA. Whila the sample selection of 36 students (20 female students and 16 male students) from class XI PMIA5 was carried out using a purposive sampling technique who had moderate academic achievement

Research Implementation (Treatment)

Biology learning activities with the STS approach assisted by E-LKPD refer to the following stages: 1) Invitation; 2) Exploration; 3) Proposing explanations and solutions; and 4) Taking action.

Collecting of data

The data taken in this study consisted of qualitative data, including student learning activities and teacher activities during learning. Quantitative data, including scores of critical thinking skills and the value of student learning outcomes obtained from evaluation activities and products (campaign media posters). Data collection techniques used are non-test techniques through observation, written test techniques with the help of evaluation questions instruments, and documentation techniques (posters and activities during online learning). The evaluation means value data is processed by quantitative descriptive analysis techniques, with the minimum completeness criteria (KKM) 75.

Data analysis

The quantitative descriptive technique is carried out by describing and describing the data that has been collected, without making general conclusions (Sugiyono, 2013). Students are categorized as complete if they get an evaluation score greater than or equal to 75, while the predicate is incomplete if the score is less than 75.

The questionnaire was conducted to obtain information on the significance of the increase critical thinking skills by a Likert score. The indications that the research action succeeded in improving student learning outcomes were: 1) The student learning outcomes reached 75 (minimum criteria), and there was an increase in the average score class from cycle 1 to cycle 2; 2) Class completeness reached 75% of the total number of students, and there is an increase in the percentage of class completeness; 3) The average product value reaches 90.

RESULT AND DISCUSSION

Findings

Class XI PMIIA5 students tend to be less motivated to participate in online learning activities. The data shows that 12.6% of the 36 students are not actively participating in online learning classes through the Google Classroom application. The data from the evaluation of online learning also shows that some students have problems with technological devices, are less motivated because they must study independently, and are late to join virtual classes because they fall asleep. The average data on Biology learning outcomes in the previous semester, class XI PMIIA5 students are in the medium category when compared to the average parallel classes taught by researchers, as shown in Table 1. below.

Table 1. Summative average grade XI PMIIA 5 before action

| No. | Description | Odd Semester 2020/2021 | |
		XI PMIIA5	Paralel Kelas XI
1.	Summative mean value	83	84.8
2.	% Completness	86.11	90.56
3.	% Incompletness	13.89	9.44

Observing the summative mean value data for class XI PMIIA5 in Table 2, before the action was below the parallel mean value for class XI. In the odd semester of the 2020/2021 academic year, the average score is 83, while the parallel average for class XI is 84.8. The percentage of completeness for class XI PMIIA5 in the odd semester is 86.11%, lower than the parallel average percentage for class XI of 90.56%. The percentage of incompleteness in class XI PMIIA5 in the odd semester is 13.89%, higher than the average parallel class percentage of 9.44%.

The observation stage in this classroom action research is carried out by researcher in collaboration with collaborators, to ensure that learning activities have truly followed the stages of the STS approach. Observations were also made on the critical thinking skills of students referring to 4 indicators, namely 1) rejecting incorrect and irrelevant information; 2) detecting and correcting conceptual errors; 3) finding new solutions and 4) making a decision or conclusion after gathering facts. The results of observations on students' critical thinking skills in cycle 1 are shown in Table 2. below.

Table 2. Average score of students' critical thinking skills in cycle 1

No.	Critical Thinking Skills Indicator	Average Score
1.	Reject false and irrelevant information	3.14
2.	Detect and correct draft errors	2.77
3.	Looking for new solutions	2.64
4.	Making a decision or conclusion after gathering facts	3.01
	Average	2.89

Based on Table 2, the average score for the indicator of rejecting incorrect and irrelevant information is 3.14 and the indicator of making decisions or conclusions after collecting facts is 3.01. Meanwhile, indicators with an average score that has not yet reached 3 are indicators of detecting and correcting conceptual errors obtaining an average score of 2.77, and indicators seeking new solutions obtaining an average score of 2.64. The average total score of the 4 indicators of critical thinking skills is 2.89. Referring to the indicators of research success, the average score of 3 indicates that the critical thinking skill indicator is included in the category of frequent occurrences, while the score of 2 is included in the category of rarely appearing in students.

Based on the results of observations of product photos in the form of posters of the 5M health protocol movement that have been uploaded by students through the Google Classroom

application, the value data is obtained as shown in Table 3. The maximum value for the very complete criteria on the text content indicator is 40, the message delivery indicator is 30, the design indicator is 20, and the image indicator is 10. The maximum value for the complete criteria on the text content indicator is 30, the message delivery indicator is 25, the design indicator is 15, and the image indicator is 8. The maximum value for the incomplete criteria on the text content indicator is 20, the message delivery indicator is 20, the design indicator is 10, and the image indicator is 6. While the maximum value for the incomplete criteria on the text content indicator is 10, the message delivery indicator is 15, the design indicator is 5, and the picture indicator is 4. The teacher gives the highest score for indicators of text content and message delivery students have received scientific knowledge concepts about the COVID-19 pandemic and have strengthened by expert opinion so that these indicators are seen as the result of reflection of students' knowledge. In addition, students also carry a mission to educate the people around them, to comply with the 5M health protocol movement.

Table 3. Average value of the 5M prokes campaign poster in cycle 1

No.	Product Rating Indicator	Average Value
1.	Fill in the text	38.71
2.	Message delivery	28.87
3.	Design	17.90
4.	Picture	9.29
Average value		94.77

Based on Table 4, the average value of the poster on the text content indicator is 38.71, the average value of the message delivery indicator is 28.87, the average value of the design indicator is 17.90, and the average value of the image indicator is 9.29. Some of the posters made by students using the suggested applications do seem very simple but do not reduce the teacher's objectivity in conducting assessments. The most important point that is the focus of the teacher's attention is that students have a moral responsibility to convey messages to the community after they get a knowledge that has been validated by experts. Data on learning outcomes of Biology material on the immune system in cycle 1 were obtained from a written test using the Google Forms application, as shown in Table 4 below.

Table 4. Average daily assessment value (PH) of students on immune system materials in cycle 1

No.	Information	Score
1.	Average (36 students)	62.8
2.	The highest score	90
3.	Lowest value	10
4.	% Completeness	33
5.	% Incompleteness	67

Table 4 shows that the average value of students' daily assessment activities on immune system material in cycle 1 is 62.8, with the highest score achieved by students is 90 and the lowest score is 10. The percentage of class completeness in cycle 1 is only 33% or as many as 12 people out of 36 students get a value greater than or equal to 75 (KKM value). While the percentage of class incompleteness reached 67%, or as many as 24 students scored less than 75. The results of the collaborator's observations of online learning activities in the first cycle of action stated that all stages of online learning on immune system material had followed the stages of STS approach.

Based on the observational data of students' critical thinking skills during online learning in cycle 1, it can be identified that the indicator for detecting and correcting conceptual errors and the indicator for finding new solutions still gets an average score of 2, which is included in the category that rarely appears in students. The two indicators in the category that rarely appear are

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the basis for consideration for teachers and collaborators to conclude that the indicators of research success for students' critical thinking skills have only been achieved by 50%. Therefore, improvement efforts are still needed to improve students' critical thinking skills in the next cycle.

The product assessment data in the form of a 5M health protocol campaign poster shows that the average value is 94.77. Although the average value is relatively high, there is one indicator, namely message delivery, whose value has only reached 28.87 from a maximum value of 30. The results of discussions with collaborators obtained recommendations that this indicator still needs to be improved, considering that the message delivery indicator is one indicator that was seen as the result of reflection of the knowledge of students.

The average value of daily assessment activities on immune system material in cycle 1 is 62.8 with the highest score achieved by students are 90 and the lowest score is 10. The percentage of class completeness in cycle 1 only reached 33% or as many as 12 people out of 36 students get a value greater than or equal to 75 (KKM value). While the percentage of class incompleteness reached 67%, or as many as 24 students scored less than 75. Referring to the indicators of research success which required the average value of students to be greater than or equal to 75 and class completeness to reach 75%, and based on the results of discussions with collaborators, then the recommendation is to take corrective action in cycle 2 to improve student learning outcomes.

Based on the results of the reflection of the actions in the first cycle, it is necessary to design learning activities with the STS approach to improve the actions of the second cycle of learning activities, include: 1) The teacher explains the indicators of critical thinking skills that will be built in learning activities, so that students are more responsible for the knowledge to be built; 2) The teacher conveys the rubric for the assessment of the campaign media, especially on indicators of text content and message delivery, so that the quality of products made by students increases; 3) Teachers actively provide guidance and direction to students in making media campaigns; 4) The teacher confirms the video shows from experts (health workers) that students observe and optimizes the content in the E-LKPD and Google Classroom so that there are no conceptual errors in building new knowledge; 5) Teachers need to review the immune system material before carrying out daily assessment activities so that student learning outcomes can be optimized.

Learning activity in cycle 2 is carried out based on the results of reflections from cycle 1. The observation is carried out by researcher in collaboration with collaborators to ensure that learning activities have followed the stages of the STS approach. The results of observations on students' critical thinking skills in cycle 2 are shown in Table 5 below.

Table 5. Average score of students' critical thinking skills in cycle 2

No.	Critical Thinking Skills Indicator	Average Score
1.	Reject false and irrelevant information	3.25
2.	Detect and correct draft errors	2.83
3.	Looking for new solutions	2.96
4.	Making a decision or conclusion after gathering facts	3.08
Average		3.03

Based on Table 5, the average score for the indicator of rejecting incorrect and irrelevant information is 3.25 and the indicator of making decisions or conclusions after collecting facts is 3.08. Meanwhile, indicators with a mean score that has not yet reached 3 are indicators of detecting and correcting conceptual errors, obtaining an average score of 2.83, and indicators seeking new solutions obtaining an average score of 2.96. The average total score of the 4 indicators of critical thinking skills is 3.03. The average score of critical thinking skills in the second cycle of action has reached a score 3, which shows that the indicators of critical thinking skills in general are included in the category that often appears in students.

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Based on the results of observations of product photos in the form of posters for the COVID-19 vaccination movement that have been uploaded by students through the Google Classroom application, value data is obtained as shown in Table 6 below.

Table 6. Average value of the COVID-19 vaccination campaign poster in cycle 2

No.	Product Rating Indicator	Average Value
1.	Fill in the text	37.74
2.	Message delivery	29.35
3.	Design	19.03
4.	Picture	9.87
Average value		96.00

Based on Table 6, the average value of the poster on the text content indicator is 37.74, the average value of the message delivery indicator is 29.35, the average value of the design indicator is 19.03, and the average value of the image indicator is 9.87. Although the text content indicator experienced a decrease in the average value, the other 3 indicators, namely the delivery of messages, designs, and images, experienced an increase in the average value. The total mean value for the product achieved by students in the second cycle is 96.00. Data on learning outcomes of Biology material on the immune system in cycle 2 were obtained from a written test using the Google Forms application, as shown in Table 7 below.

Table 7. Average daily assessment (PH) of students on immune system materials in cycle 2

No.	Information	Score
1.	Average (36 students)	75.17
2.	The highest score	90
3.	Lowest value	20
4.	% Completeness	77
5.	% Incompleteness	23

Table 7 shows that the average value of students' daily assessment activities on immune system material in cycle 2 is 75.17, with the highest score achieved by students is 90 and the lowest score is 20. The percentage of class completeness in cycle 2 increased to 77%, or as many as 27 people out of 36 students scored greater than or equal to 75 (KKM score). While the percentage of class incompleteness became 23%, or as many as 9 students scored less than 75. The results of the collaborator's observations of online learning activities in the second cycle of action stated that all stages of online learning on immune system material had followed the stages of STS approach. Learning activities have also referred to the results of the recommended reflections in cycle 1.

Based on the observational data of students' critical thinking skills during online learning in cycle 2, it can be identified that the indicator for detecting and correcting conceptual errors and the indicator for finding new solutions still gets an average score 2, which means that it is still included in the category that rarely appears in students. However, the average score in general for all indicators of critical thinking skills has reached a score 3.03, which means that it is included in the category that often appears in students. Referring to the indicators of research success related to improving students' critical thinking skills, that research is declared successful if the average total score reaches a number greater than or equal to 3.

The product assessment data in the form of a COVID-19 vaccination campaign poster shows that the average value is 96.00. This value has increased from the value in the first cycle. The increase in value comes from 3 product assessment indicators, namely message delivery, design, and images. Based on the research success indicators that have been formulated, the research action is categorized as successful if the average product value is greater than or equal to 90.

The average value of daily assessment activities on immune system material in cycle 2 is 75.17, with the highest score achieved by students are 90 and the lowest score are 20. The percentage of class completeness in cycle 2 reached 77% or as many as 27 people out of 36 participants. students get a value greater than or equal to 75 (KKM value). While the percentage of class incompleteness is 23%, or as many as 9 students get a score of less than 75.

Referring to the indicators of research success that have been determined, the research is categorized as successful if the average student learning outcomes reach a value of 75 and there is an increase in the class average value from cycle 1 to cycle 2. Other research success criteria are class completeness reaching 75% of the total number of students, as well as an increase in the percentage of class completeness.

Based on the results of observation of the data in the second cycle and the results of the researcher's discussion with collaborators, it is recommended that research actions do not need to be continued in the next cycle because the indicators of research success have been met in the second cycle of action, which includes:

Critical thinking skills

Success indicator: the average total score reaches 3 (the category often appears), there is an increase in the average score from cycle 1 to cycle 2. Action results: the average total score in the first cycle is 2.89, while the second cycle is 3.03 (the category often appears), there is an increase in the average score of 0.14 points. Value of learning products (posters or media campaigns). Success indicator: average product value reaches 90. Action results: the average value of the product in the first cycle is 94.77, while in the second cycle is 96.00.

Learning outcomes of immune system material

Success indicator: learning outcomes reached a value of 75, there was an increase in the class average value from cycle 1 to cycle 2, class completeness reached 75%, and there was an increase in the percentage of class completeness. Action results: the average learning outcomes in the first cycle is 62.8, while in the second cycle is 75.17, there is an increase of 12.37 points; class completeness in cycle 1 was 33%, while in cycle 2 it was 77%, an increase of 44%.

Discussion

The learning process of Biology subjects, especially on immune system material, becomes more meaningful if there is a combination of aspects of knowledge, technology, and the implementation of that knowledge in society. As stated by John Ziman, that the STS approach is a learning approach that uses technology as a liaison between science and society (Suteja & Wijayanti, 2017). Learning with the STS approach is an alternative approach, which accommodates the needs of teachers to bring students to the technology-based implementation stage. The main hope is that students will become more and more interested in studying Biology further. STS has special characteristics, namely raising environmental issues that aim to help students understand the relevance of science to everyday life (Kumar and Chubin, 2000). Learning with the STS approach is divided into 4 stages, namely 1) invitations; 2) exploration; 3) proposing explanations and solutions, and 4) taking action, through 2 cycle of classroom action research (CAR) with a total of 2 face-to-face meetings in each cycle.

In the first cycle, the teacher carries out the invitation stage by awakening students' memories regarding the issue through showing several videos about the COVID-19 pandemic phenomenon in several countries and the 5M health protocols movement (wearing masks, washing hands, maintaining distance, avoiding crowds, and reducing mobility). In the exploration stage, the teacher asks students to build concepts related to the background of the emergence of the COVID-19 pandemic in several countries. Researchers encourage students to seek information about the

background to the launching of the 5M health protocols movement through various sources. At the stage of proposing explanations and solutions, the teacher asks students to present explanations about the background of the emergence of the COVID-19 pandemic in several countries. The researcher asked students to provide scientific reasons why they should do the 5M health protocols movement. At this stage, the researcher guides students to combine concepts generated by students with opinions from experts, as well as testimonials from COVID-19 survivor (one of the students who is confirmed as a COVID-19 survivor). After building the concept of new knowledge, at the stage of taking action, the researcher asked students to apply knowledge related to the 5M health protocols movement by campaigning through poster media (using Powerpoint and Poster MyWall applications) to their family or friends.

The positive value that can be taken from the action in cycle 1 is that students are able to compose posters related to the 5M health protocol movement. Students do not just pour their creativity, but also have a scientific basis to explain the purpose of the images made, especially to convince family or close friends. Students are able to explain the reasons why they must use soap (not only water) when washing their hands, and why they must use double layer masks. Through the STS approach assisted by E-LKPD, students are able to get closer to scientific facts validated by experts so as to avoid misleading news (hoax). Students are also expected to be able to assess themselves, whether the 5M health protocol movement that has been carried out is in accordance with the scientific concepts that have been understood after learning.

In the second cycle, the researcher carried out learning with the same stages as in the first cycle, but improvements were made that refer to the results of reflection on the first cycle. These improvements include, among others, recommending that 1) the teacher explains the indicators of critical thinking skills that will be built; 2) the teacher conveys the rubric for the assessment of the campaign media; 3) teachers actively provide guidance in making media campaigns; 4) the teacher confirms the video from the expert (health worker); 5) the teacher reviews the immune system material before carrying out the daily assessment activities.

At the invitation stage, the social presented social issues related to the working mechanism of the immune system and the vaccination movement. In the exploration stage, the teacher asks students to build concepts related to the scientific reasons that vaccines are needed to overcome COVID-19 and the mechanism for forming antibodies. Educators encourage students to seek information from various sources, how the body responds to the incoming vaccine. At the stage of proposing explanations and solutions, the teacher asks students to present the scientific background on the need for a vaccine to overcome COVID-19, as well as the mechanism for forming antibodies after vaccination. At the end of the presentation session, the teacher guides the students to combine the concepts generated by the students with the explanations delivered by the health workers. In the taking action stage, the teacher asks students to share the knowledge that has been gained by conducting a campaign on the importance of vaccination with the closest people (family or friends).

The positive value that can be taken from the action in cycle 2 is that students are able to explain scientifically why they should follow the COVID-19 vaccination movement, how the body will respond to form an immune system, and what happens when someone is exposed to the corona virus before getting vaccinated. After participating in learning activities by observing the issue of vaccination, students are expected to understand (and campaign for) the importance of vaccination to protect the body from corona virus attacks. The element of technology developed in learning activities is the use of applications on social media, namely Tik Tok and Twibbonize. Both applications are very close to students, especially since the pandemic occurred. The application in the form of short video clips and images is expected to be a media campaign, to convince those closest to students to participate in the vaccination program. Based on the observational data on students' critical thinking skills in cycles 1 and 2, the average score of critical thinking skills was obtained as listed in Table 8.

Table 8. Average critical thinking skills score in cycles 1 and 2

No.	Indicator	Cycle 1	Cycle 2
1.	Reject false and irrelevant information	3.14	3.25
2.	Detect and correct draft errors	2.77	2.83
3.	Looking for new solutions	2.64	2.96
4.	Making a decision or conclusion after gathering facts	3.01	3.08
	Average	2.89	3.03

The indicator rejects incorrect and irrelevant information which originally in cycle 1 got an average score 3.14, rose to 3.25 in the cycle 2. The indicator detects and correct draft errors got an average score 2.77 in cycle 1 rose to 2.83 in cycle 2. The indicator looking for a new solution which originally in cycle 1 got an average score 2.64 rose to 2.96 in cycle 2. While the indicator makes a decision or conclusion after collecting facts which was originally in cycle 1 gets an average score 3.01 rose to 3.08 in the cycle 2.

Referring to the indicators of research success related to increasing students' critical thinking skills, that research is declared successful if the average total score reaches a number greater than or equal to 3. An increase in critical thinking skills score of 0.14 points in this study indicates that a series of learning actions with an approach STS is able to improve students' critical thinking skills. A learning environment that enables the empowerment of critical thinking skills allows students to apply critical thinking skills (Suyono & Haryanto, 2014).

Increased critical thinking skills also correlate with changes in student behavior, as stated by Giambattista that when students experience the event themselves, their cognitive structure is able to accept and construct in their minds, then the person concerned will have the ability to explain the elements that build 'something'(Ziman, 1980). Based on the observational data on the campaign posters made by students in cycles 1 and 2, the average value is obtained as listed in Table 9 below.

Table 9. Poster average score on cycle 1 and cycle 2

No.	Product Rating Indicator	Cycle 1	Cycle 2
1.	Fill in the text	38.71	37.74
2.	Message delivery	28.87	29.35
3.	Design	17.90	19.03
4.	Picture	9.29	9.87
	Average	94.77	96.00

The text content indicator in cycle 1 got an average value of 38.71, down to 37.74 in the cycle 2. The message delivery indicator which was originally in cycle 1 got an average value of 28.87, increased to 29.35 in the cycle 2. The original design indicator in cycle 1, the average value was 17.90, increasing to 19.03 in the cycle 2. While the image indicator in cycle 1 received an average value of 9.29, it rose to 9.87 in the action cycle 2. In general, the average value of all assessment indicators posters increased from 94.77 in cycle 1 to 96.00 in cycle 2, or an increase of 1.23 points.

The increase in the value of the poster in this study is inseparable from efforts to improve the action recommendations of reflection activities in cycle 1, namely the teacher conveys the rubric of the media campaign assessment, especially on indicators of text content and message delivery, so that the quality of products made by students increases. Another corrective action is that the teacher actively provides guidance and direction to students in making media campaigns. Based on the data on the results of student evaluation activities in cycles 1 and 2, the average value is obtained as listed in Table 10 below.

Table 10. Average value of daily assessment results in cycles 1 and 2

No.	Aspect	Cycles 1	Cycles 2
1.	Average	62.8	75.17
2.	The highest score	90	90
3.	Lowest score	10	20
4.	% Completeness	33	77
5.	% Incompleteness	67	23

The action data shows that the average value of student evaluation in cycle 1 is 62.8, while in cycle 2 is 75.17. In the first cycle with the 5M health protocol movement material, the average value of the evaluation of students was categorized as not reached the minimum completeness criteria (KKM = 75) because it only reached 62.8. But in the second cycle with the material of the vaccination movement, the average value of the evaluation of students increased to 75.17 or increased by 12.37 points and was categorized as having achieved minimum completeness. The percentage of students who completed the first cycle was 33%, rising by 44 points so that it reached 77% completeness. While the percentage of the number of students who have not completed cycle 1 is 67%, decreased by 44 points to 23% in cycle 2. This means that many students have not completed the a cycle 1 after participating in the learning activities in cycle 2 has increased learning outcomes.

The improvement of learning outcomes in this study cannot be separated from efforts to improve the actions of the recommendations for reflection activities in cycle 1, namely, the teacher confirms related video shows from experts (health workers) that are observed by students and optimize the content in E-LKPD and Google Classroom, so that students do not have the wrong concept in building new knowledge.

The improvement of student learning outcomes who apply the STS approach in learning activities is also supported by another study conducted (Sugiyono, 2013). The results showed that there was a tendency for students to have higher science learning outcomes. A similar study conducted by Santoso et al., (2013) entitled "Application of the STS Model Through Field Experiments and Laboratory Experiments Viewed from Environmental Care Attitudes and Students' Verbal Creativity" also shows that the application of the STS model has an effect on cognitive learning achievement. affective, and psychomotor students.

These findings are consistent with the research conducted by (Aktamis & Ergin, 2008), namely that the STS approach is able to improv students' critical thinking ability, because the STS approach focuses more on technology and society in learning science logically (Mulyanti et al., 2021)

According to (Owen et al., 2020), learning with the STS approach can improve students' scientific and technological literacy. Scientific literacy is the ability to read and write (O'toole et al., 2020), or the ability to communicate through writing and words (Jarman et al., 2012), and its application to the needs of society. While technological literacy is defined as the ability to implement technology based on the ability to identify (Ingerman & Collier-Reed, 2011), be aware of the effects of technology (Nikou et al., 2022), and be able to behave and be able to use the base safely, appropriately, efficiently, and effectively (Razak et al., 2022).

CONCLUSION

Learning by applying the STS approach with the help of E-LKPD to improve critical thinking skills and learning outcomes of biology material on the immune system in class XI science students at SMA Negeri 2 Yogyakartaa is carried out through stages 1) Invitation, 2) Exploration, 3) Proposing explanations and solutions, 4) Taking action. The critical thinking ability of students has increased from cycle 1 to cycle 2 by 0.14 points. The indicator rejects incorrect and irrelevant information which originally in cycle 1 received an average score of 3.14, increasing to 3.25 in the cycle 2. The indicator detects and correct draft errors got an average score 2.77 in cycle 1 rose to 2.83 in cycle 2. The indicator looking for a new solution which was

originally in cycle 1 got an average score of 2.64 rising to 2.96 in the cycle 2. While the indicator makes a decision or conclusion after collecting facts which was originally in cycle 1 gets an average score of 3.01 increased to 3.08 in the cycle 2. The average value of the students' evaluation increased by 12.37 points from 62.8 in the cycle 1 to 75.17 in the cycle 2. Percentage of the number of students who completed the cycle 1 by 33%, an increase of 44 points so that it reaches 77% completeness in the cycle 2. While the percentage of the number of students who have not completed the action class 1 was 67%, decreased by 44 points to 23% in the cycle 2.

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