STUDENTS' CRITICAL THINKING SKILLS IN LEARNING PHYSICAL AND CHEMICAL CHANGES THROUGH HYBDRID LEARNING

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Abstract: Online learning in Pandemic COVID-19 requires teachers to be more creative and innovative. Among of them, in dealing with the implementation of science experiment which is needed to build critical thinking skills of students through real phenomena that they do and observe by themselves. Students are possible to do a simple science experiment of physical and chemical changes utilize simple apparatuses and available local materials at home. This study aims to analysis student's critical thinking in combined online learning (practice assignments, and online discussions) and hands on activities of physical and chemical change at home. Based on the results of descriptive research of student's dialogue analysis during the learning process (online session), it was found that this learning is able to involve all students in critical thinking activities according to Ennis (1985) indicators. In the introduction session (main room) it was found one indicator of critical thinking skills activity with a percentage of 47%. In 1st session, group discussion activities (breakout room 1), it was found 4 critical thinking indicators with a percentage of 80%. In class discussion activities (main room), it was found 6 critical thinking indicators with a percentage 100%. In session 2 group discussion activities (breakout room 2), it was found 3 critical thinking indicators with a percentage of 40%. And In the closing session, it was not found critical thinking activity. From the results of this study, it can be said that the combination of online and hands on methods might be an alternative to the implementation of study at home to build students' critical thinking, within the allocation of learning time.

Keywords: critical thinking skills, physical and chemical changes, hybrid learning.

INTRODUCTION

Each subject has unique characteristics and requires a certain method in teaching it. Likewise with science. Science learning is identical to the implementation of scientific experiment, the application of the scientific method which is believed to make an important contribution in developing the thinking process [1]. Referring to the 2013 curriculum, providing hands-on experience to develop skills to explore and understand the environment scientifically becomes the focus of the science learning process, especially at the junior secondary level [2].

Therefore, online learning that is carried out during the study at home program in the COVID-19 pandemic requires teachers to be more creative and innovative. Realizing a meaningful, fun, student-centered learning in accordance with the demands of the 2013 curriculum in very limited situations and conditions is a challenge in itself in the implementation of learning in this COVID-19 pandemic. Among them are in dealing with the implementation of science experiment which is needed to build skills in exploring real phenomena that they do and observe for themselves. More than that, this learning is expected to build critical thinking skills, one of the basic skills that must be possessed to be survive in the 21st century [3]–[5].

The results of several studies explain that science experiment can be carried out through online learning [6]–[10]. It can be done directly in virtual learning [6], either through project activities [7], or assignments [8]–[10]. The effective time for conducting online practicums ranges from one to three hours[6]. There are several things that must be considered when carrying out online learning science experiment, including the selection of the right material, careful planning, clear guidelines, and the availability of apparatus and materials [7], [9], [10].

The implementation of the online learning science experiment is able to promote independence of students, train communication and collaboration skills, provide students with more flexible time and place of implementation [10]. However, the availability of apparatus and materials [7], [9], [10], as well as the difficulty of understanding the practicum results [6], [10], often become obstacles.

Based on the results of the analysis that has been described, the researchers tried to plan a hybrid learning, namely carrying out assignments of science experiment practicum activities at home using local materials and virtual learning to share as well discuss scientific process using one of the teleconference platforms.

The concept of physical and chemical changes which is one of the science contents of 7th grade junior high school is very possible to be taught using this method. The purpose of this research is to reveal the critical thinking skills of students in learning physical and chemical changes through a hybrid learning.

METHOD

Research Subject

The research subjects were 15 students of grade 7 at a junior high schools in Sumedang Regency. These fifteen students were selected students out of five classes taught by the researcher, who were able to participate in virtual learning. Most of my students do not have facilities to join virtual learning due to parent economy background could not afford to facilitate his/her child with laptop or smart phone and internet connection. The challenge of implementation of virtual online learning is the ability of parents to provide laptop/smart phone and internet connection.

Research Activities

1) October 12, 2020.
   a) Distributed student worksheets as a guide for experiment assignment to be carried out at home. Worksheets must be owned and filled out by every student.
   b) The teacher asked students to read and understand the contents of the worksheet, invited students who did not understand to ask questions using the IPA WhatsApp group facility.
   c) The teacher informed that the science experiment must be carried out independently because the conditions did not allow for group work, except for students whose houses are close each other, they are allowed to work in groups with a maximum of 4 members.
   d) The teacher and the students made an agreement regarding the length of time needed to do the science experiment, which is for two weeks. Students were required to document the process of experiment in the form of videos and the filling worksheet. Both collected data video and worksheet were collected at least one day before the virtual learning which was held on October 26, 2020.
   (During experiment assignments at home, students could ask questions and discuss using the IPA WhatsApp group facility).
2) October 26, 2020.
   The implementation of virtual learning by a zoom meeting to discuss the results of the science experiment. The virtual learning aactivities were carried out for 3 x 40 minutes. In this activity, my colleagues of two teachers helped me to observers student activities. The virtual learning were divided into 4 sessions, namely:
   a) Opening session
   Reviewing students' understanding of the concepts of physical and chemical change that they have acquired in elementary school. And check students' hypotheses before carrying out the experiments. This activity lasts for 20 minutes. Students are divided into 5 groups, each group consists of 3 students.
   b) Group Discussion Session 1
   Students shared, discussed, exchanged information about the results of the experiment within their groups in the break out room facility. This activity lasts for 25 minutes.

c) Class Discussion
After carrying out the group discussion session 1, students returned to the main room to conduct class discussions. At this stage, students are facilitated by the teacher to discuss the results of the experiment based on the student worksheets. This activity lasts for 55 minutes.

d) Group Discussion Session 2
After carrying out class discussions, students return to the breakout room to discuss with their respective groups, correcting answers based on the results of class discussions. This activity lasts for 15 minutes.

e) Closing session
After carrying out the class discussion, students return to the main room. In the closing activity, the teacher confirmed the understanding of students, provided opportunities for students to ask questions, and informed assignment for the next meeting. This activity lasts for 5 minutes.

The research was carried by applying qualitative methods, an in-depth study to get a whole picture of what was observed [11]. The purpose of this study is to obtain an overview of students' critical thinking skills in learning activities of physical and chemical changes applying hybrid learning. Students' conversation was video recorded during learning activities. In this study, the transcript of students' conversations during learning activities was analyzed and matched using indicators of critical thinking skills [12].

Observation notes by observers can additional data used in this study. In addition, the researcher also distributed a questionnaire to reveal students' impressions of the learning that had been carried out, the obstacles faced, and expectations for the ideal and fun implementation of science learning for them.

The data in the form of student conversations during learning were then transcribed and analyzed. This analysis is used as one way to investigate the characteristics of learning [13].

The analysis process begins by transcribing all student conversations during virtual learning, then coding the dialogue based on indicators of critical thinking skills [12]. Based upon the results of this coding, it was found the percentage of students' critical thinking activities, the percentage of statements of critical thinking skills by students, and the types of critical thinking skills that appear during the learning process. The data collected through questionnaires and observations helped researcher to understand deeply students learning process.

RESULTS AND DISCUSSION

In this study, the science experiment was carried out by the assignment method (carried out at the homes of each student) either independently or in groups (for students whose houses were close each other) with the number of group members maximum of 4 people. The science experiment activities were guided by worksheets equipped with questions that must be answered based on the results of the experiment and the students' initial understanding of the concepts of physical and chemical changes at elementary school. The results of this experiment was discussed in virtual learning.

Through this research, an objective investigation was conducted on the critical thinking activities of students including the number of critical thinking indicators that appeared in each learning session, the percentage of the frequency of statements of critical thinking skills expressed by students, and the number of students who showed critical thinking activities. In addition, researchers also identified indicators of critical thinking skills that emerged during the virtual learning process. The entire investigation was carried out based on the results of the transcript analysis of all student conversations during virtual learning referring to indicators of critical thinking skills [12].

Students' Critical Thinking Skills Activities

The results of the analysis of student conversations related to the activities of students' critical thinking skills in the virtual face-to-face learning process using transcript analysis refers to the indicators of critical thinking skills [12] which can be seen in "Table 1".

TABLE 1. Students' Critical Thinking Activities

Learning Activities	Number of Critical Thinking Indicators (Ennis, 1985)	Frequency of Critical Thinking Statements (%)	Number of Students Showing Critical Thinking Activities (%)
Opening	1	39	47
Group Discussion Session 1	4	32	80
Class Discussion	6	45	100
Group Discussion Session 2	3	25	47
Closing	0	0	0

If we present the data in graphical form, then the picture of the data can be showed in "Fig.1

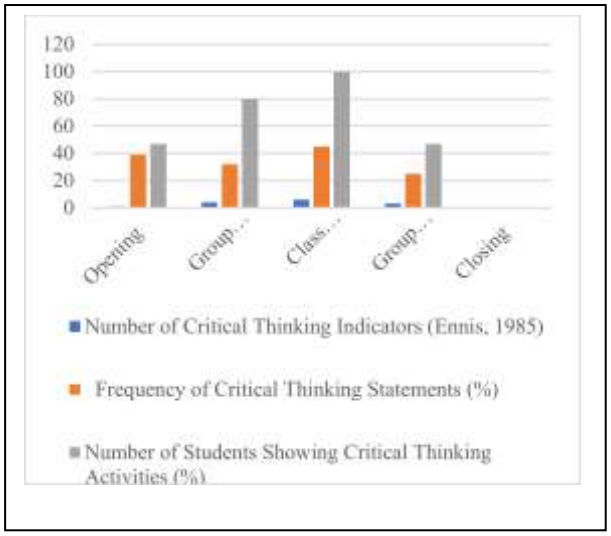

Fig.1 Students' Critical Thinking Activities

From the tables and graphs, it can be seen that there is an increase in students' critical thinking skills activities in line with the increasing emergence of critical thinking indicators, and the number of students who carry out critical thinking activities, from initial activities to class discussions. But then the students' critical thinking skills activity decreased in the group discussion activity session 2. And in the closing activity there was absolutely no student's critical thinking activity. The percentage frequency of critical thinking statements does not follow the same pattern, where the high number of students who show critical thinking activities, and the emergence of many critical thinking indicators are not always directly proportional to the high frequency of critical thinking statements expressed by students. This may happen because in the learning process there can be repetition of statements by several students, so that even though the number of students who show critical thinking activities is small, statements can appear in a high frequency.

The data also illustrates that there are factors that influence students' critical thinking activities, which we can explore from the results of observations and answers to questions on the questionnaire given to students.

The first factor is the duration of virtual learning, because the long duration of virtual learning cause boredom[14] and cause physical complaints [14], [15]. According to students' voice, that they felt happy and understood with the real science experiment (face-to-face) activities, but during virtual learning they complained of aches and bit bored.

Based on the observation notes, information was obtained that when creating in groups, students in groups 1, 2, and 4 looked confused, didn't know what to do. Each student already had data on the results of the experiment but to combine it within a group of friends it takes a long time to wait. After the teacher joined the break out room and asked the students to exchange information, then they started discussing, and even then it did not go smoothly, because in the group of students still seemed embarrassed to express their observations and give explanations to their friends.

The reason for this was revealed through students' answers to the questionnaire that they felt awkward when carrying out group discussions. This happens because they do not know each other, except for students who have group friends from the beginning (students whose houses are close each other) such as in group 3, and there is one student who is already accustomed to discuss learning patterns so that he became a leader (group 5).

Awkwardness is very possible in online learning, especially for 7th graders in the first semester. The personality of students greatly influences the course of the discussion process [16], [17], where some students need emotional security to be able to express opinions to peers and teachers [16]. Therefore it takes time and habituation so that students are able to discuss and build their critical thinking skills through these activities.

The clarity of instructions from the teacher before group discussion is also very decisive in determining students' understanding [18], [19], and this greatly affects the course of group discussions and the process of building students' critical thinking skills. So before students have group discussions in the break out room, make sure they understand what they have to do.

Teachers have a very important role so that students are involved in learning activities [19], [20], and build their critical thinking skills. This can be seen during class discussions, where the teacher facilitates the discussion. Students become more active, it can be seen from the data that in this session all students showed critical thinking activities. Guiding questions and inquiry questions expressed by the teacher when facilitating class discussions help students to carry out discussions productively [16] and provide explanations [19]–[21], which means they are helped in carrying out critical thinking activities.

So the interaction between students, teachers, and materials is needed to build students' critical thinking skills. This is in line with the statement that there must be interaction between teachers and students, students with students, and students with materials so that the learning process increases [20].

Indicators of Critical Thinking Skills that Appear During the Virtual Learning Process

There are 12 indicators of critical thinking [12], respectively, from the first indicator to focus on questions; analyze arguments/statements; ask or answer an explanation or challenge; consider sources; observe and consider the results of observations; deduce and consider the results of the deduction; induce and consider the results of induction; consider; identify terms and consider definitions of strategy form and content; identify assumptions; decide on the action to be taken; and interact with other people.

In the learning process, not all indicators appear. Based on the results of the transcript analysis, there are 6 indicators of critical thinking skills [12] that appear during the learning process as shown in "Fig.2".

Fig.2. Percentage of Frequency of Students' Critical Thinking Statements on Each Indicator

We can see that in the opening activity, only 3 indicators (ask or answer a question or challenge) appeared as much as 39%. We can relate this to the learning process in the opening activity, namely a review of the concept of physical and chemical changes in elementary school. There was a question and answer process between the teacher and students. The question and answer activity has the potential to build critical thinking skills in terms of asking or answering a question or challenge.

In discussion activities, both group discussions and class discussions, more than one critical thinking indicator appears. Indicators 1, 4, 5, and 7 appear during group discussion session 1. Indicators 1, 2, 3, 4, and 7 appear during class discussions. In the group discussion session 2, indicators 1, 3, and 7 appeared. And in the closing activity, indicators for critical thinking skills did not appear.

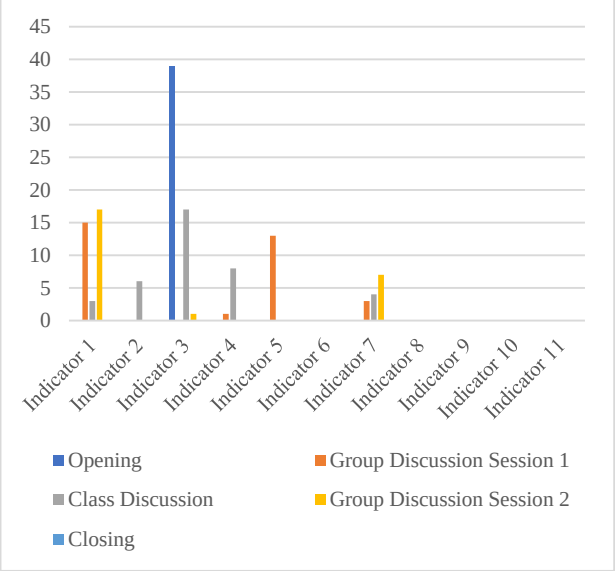

Fig.2. . Percentage of Frequency of Students' Critical Thinking

If we examine the learning process in each activity session, we can see that the number of learning activities is able to bring up many indicators of critical thinking. This shows that learning activities are a means to build students' critical thinking skills. For example, in the opening activity, only question and answer is conducted, then what is built is an indicator of critical thinking skills number 1. In group discussion activities, students do more than just question and answer. They exchange information, confirm the correctness of each member's answers, and draw conclusions. This activity succeeded in building and raising more critical thinking skills, not just indicator number 1. In class discussion activities, student learning activities were more involved by involving many students and with the help of teacher guidance, so that students' critical thinking skills activities were much more visible. On the other hand, in the closing activity, only reinforcement was carried out by the teacher and the opportunity to ask students questions. If students feel they understand and there is no need to ask questions, then in this activity there are no indicators of critical thinking skills that appear.

This is in line with the statement that learning activities are the basis for achieving learning goals and outcomes [22]. These learning activities involve not only physical activity, but also mental activity [23].

CONCLUSION

From the results of the research that has been done, it can be concluded that the hybrid learning can be an alternative to get around the implementation of science experiment during the learning at home period. Through this learning, students' critical thinking skills were built. In order for learning to be carried out, there are several things that must be considered, namely: determining concepts that are possible to be taught using a hybrid learning (practice assignments and discussion of science experiment results in virtual learning); availability of apparatuses and materials, as well as student work safety and security. In this case the apparatuses and materials needed were easy to find in everyday life, and not dangerous; clear experiment guidelines (teachers must provide worksheets that are able to guide students in carrying out science experiment at home); the existence of facilities for discussion during the implementation of the experiment at home.

Time management during virtual learning must be considered. Long time virtual learning can cause boredom and physical complaints for students and this will greatly affect the achievement of learning objectives.

Students' critical thinking skills are influenced by internal and external factors. Internal factors concern with the personality of students and the comfort of students in the learning process. External factors include teacher guidance, peer influence, clarity of material including clarity on worksheets, and diversity of learning activities.

This study also illustrates that research on students' critical thinking skills still needs to be carried out. By using other learning methods, which are in accordance with the characteristics of students and learning materials.

Analysis of transcript is able to reveal students' critical thinking skills. More than that, this analysis is also able to provide an overview of the trajectory of students' understanding during the learning process. Therefore, transcript analysis can be recommended as a technique to reveal students' abilities and/or skills through their conversations during the learning process.

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