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Application of Inquiry Collaborative Constructivism Model in Biology Learning Respiratory System to Improve Students' Critical Thinking Skills

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Abstract

Currently all alternatives to meet the needs of life in various contexts are based on knowledge. Developing critical thinking skills is an important aspect of academic studies. Inquiry-based learning is a contextual learning model that can make students participate actively during learning. The purpose of this study was to review the effectiveness of the application of the inquiry-collaborating constructivism model in biology learning. The type of research conducted was a quantitative approach through pre-experimental methods. The design of this research was One-group pre-test-post-test design. This research was carried out at SMAN 1 Jamblang precisely in class XI MIPA in the even semester of the 2019-2020 school year. The instruments used were observation sheets and test questions. The results of the average value of the student activity showed results with very good criteria for each meeting. Based on the hypothesis test, it was known that the 2-tailed significance was < 0.05. This indicated that there was a significant difference between the pre-test and post-test scores after the application of the inquiry-collaborating constructivism learning model. The application of the inquiry-collaborating constructivism model was considered effective in improving students' critical thinking skills.

1. INTRODUCTION

Education in Indonesia emphasizes the development of the 21st century and refers to the competition for human resources in the globalization era. Wijaya et al. (2016) explained that the 21st century is known as the era of knowledge. Currently, all alternatives to meet the needs of life in various contexts are based on knowledge. Education as part of efforts to improve the welfare of human life is part of national development.

A study conducted by Trilling and Fadel explained that human resources for higher education graduates are still less competent in critical thinking and facing problems. Therefore, critical thinking skills can be derived to be more developed further at the level of education before higher education

(Trilling & Fadel, 2010). Nafiah and Suyanto (2014) argued that in the development of the 21st century, five contexts require specific competencies, namely: (1) global competition conditions that require global awareness and independence; (2) global cooperation conditions require cooperation capabilities and mastery of ICT; (3) information growth requires critical thinking and problem solving; (4) work and career development requires critical thinking and problem solving, flexible, and adaptable innovation and improvement, (5) service-based economic development requires critical thinking and problem-solving.

Critical thinking is reasoning and deep awareness of what is received from different ideas, meaning that ideas and suggestions from someone about a phenomenon or event cannot be fully accepted if the concept does not run systematically and is a logical truth-seeking process (Nursyahidah & Albab, 2018). Critical thinking skills are very useful in everyday life (Salirawati et al., 2021). The ability to think critically is the primary goal of education for a higher level. Khartaningtyas and Rosdiana (2020) stated that developing critical thinking skills is an important aspect of academic studies. Critical thinking skill has various benefits, such from a social perspective, it can foster a spirit of responsibility so that people can make good decisions based on a careful and detailed evaluation of the evidence in the real world.

Several studies show that students' critical thinking skills need to be improved (Suana, & Maharta, 2019; Amalia, & Kamaludin, 2019). Critical thinking skills can be improved through inquiry learning (Muhan, & Nasrudin, 2021). Inquiry learning can improve learning outcomes, self-efficacy, scientific attitudes, and science process skills (Apriliana et al., 2019; Nikmah et al., 2020; Hidayah, & Imaduddin, 2015). Biology learning using inquiry can improve biological literacy (Ahyadi et al., 2018).

Constructivism theory is the knowledge obtained by a child in the form of construction results from the initial knowledge he already has with the newly acquired knowledge. Previously, the use of constructivism theory in learning has been carried out by Oktavianti et al. (2018) to form problem solving abilities. As a result, students' problem-solving skills increase compared to conventional learning. The constructivism-based model of constructivism has been applied by Putrayasa (2010) to support Indonesian language learning. The results show that students who are taught using the inquiry-based constructivism model are better at learning the concepts being taught compared to students who are taught using the conventional models.

Inquiry-based learning is a contextual learning model that can make students active in participating during learning. Suparno (2007) states that inquiry is an approach that involves students' critical thinking skills to analyze and solve problems systematically. The process is through identifying problems, creating hypotheses, collecting data, analyzing data, and making decisions through steps that will guide students to find a principle, law, or theory.

Based on the problems that have been mentioned, the purpose of this study is to review the effectiveness of the application of the inquiry-collaborating constructivism model in learning biology. The test is proven from whether the inquiry-collaborating constructivism model improves students' critical thinking skills, which can improve the quality of human resources in Indonesia.

2. METHOD

The type of research conducted was research with a quantitative approach through pre-experimental methods. The design of this research was One-group pre-test-post-test design. Arifin (2011:77) wrote the design structure of the One-group pre-test-post-test design at Table 1.

Table 1. Research Design One-Group Pretest-Posttest Design

Group	*Pre test*	Treatment	*Post test*
E	O_1	X	O_2

Keterangan :

E = Experiment Class

O_1 = *Pre test* (Before being treated)

O_2 = *Post test* (After being treated)

X = Treatment with the application of biology learning using a constructivism model of collaborative inquiry.

This research was carried out at SMAN 1 Jamblang precisely in class XI MIPA in the even semester of the 2019-2020 school year. The study was conducted for 1 month, starting from January 2020 to February 2020. The population in this study were all students of class XI MIPA at SMAN 1 Jamblang as many as 4 classes totaling 140 students, each class consisting of 35 students. The sample in this study were students of class XI MIPA 5 at SMAN 1 Jamblang, totaling 35 students. The sampling technique in

this research was to use probability sampling using random sampling technique. Critical thinking skills test instrument to measure indicators 1) analyzing, 2) synthesizing, 3) evaluating, 4) generalizing (Nafiah, 2014; Nold, 2017). Inquiry-collaboration skills observation instruments included 1) orientation, 2) formulating problems, 3) formulating hypotheses, 4) collecting data, 5) test hypotheses and 6) formulate conclusions (Hanif et al., 2016; Yuliati et al., 2018). This research instrument used student activity observation sheets and multiple-choice test questions. The research data were analyzed using SPSS version 21.0 software.

3. RESULTS AND DISCUSSION

The results of this study were obtained after conducting research on 35 students of class XI MIPA 5 at SMAN 1 Jamblang. The class XI MIPA 5 students were given treatment in the form of learning biology using a constructivism model of collaborative inquiry in the concept of the respiratory system, then measuring students' critical thinking skills after the learning was completed. The treatment was given for three meetings. The results of the research will discuss student activities when implementing learning using the inquiry-collaborating constructivism model and improving critical thinking skills through student learning outcomes after learning is applied.

The first thing that can be reported from the research results is student activities. Student activities are student activities during class learning. The research conducted was to observe student activities through direct observation sheets. The results of the observation of student activities will show the difference in the average value of student activities at each meeting and the differences in the average value of student activities on each indicator of the inquiry-collaborating constructivism model. Student activities are observed at each session, and the results are illustrated in Figure 1.

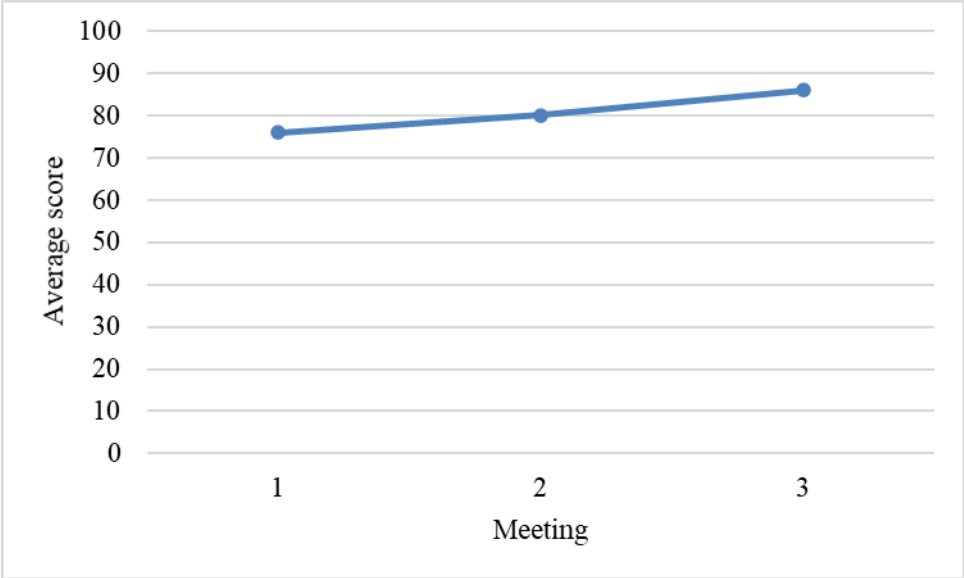

Figure 1. Differences in the average score of student activities at each meeting

Based on Figure 1, it can be seen the difference in the average score of student activities in each meeting. The average value of student activity at the first meeting was 76; in the second meeting student activity increased again, namely 80; and at the third meeting, the result was 86. At the third meeting, there was an increase in the average value of student activity by six scores. The results of the average value of the student activity showed results with very good criteria for each meeting. This proves that the application of biology learning using the inquiry-collaborating constructivism model can increase student activity during class learning.

Constructivism is an approach that emphasizes the level of student creativity in channeling new ideas or ideas needed for student self-development based on knowledge. This model prioritizes student activities, and the teachers only act as mentors and teachers in learning activities. The constructivism approach is said to be very suitable to be collaborated with the inquiry learning model because as explained by Piaget (Rahman (2018) that constructivism can draw an identity or self-concept and form cognitive structures and strategies. Vygotsky also explains that knowledge is formed socially, namely on what each is contributed and created simultaneously.

Student activities were observed using student worksheets whose designs were made according to the indicators of the inquiry-collaborating constructivism model proposed by Hanif et al., (2016), namely 1) orientation, 2) formulating problems, 3) formulating hypotheses, 4) collecting data, 5) test hypotheses and 6) formulate conclusions. This study uses the inquiry model because, in our perspective, this model is very suitable to be used to develop students' critical thinking skills. The use of this model is intended to solve a problem independently, as stated by Budur (2012) that the inquiry model is based on problems so that it can train students to solve problems based on independent investigation.

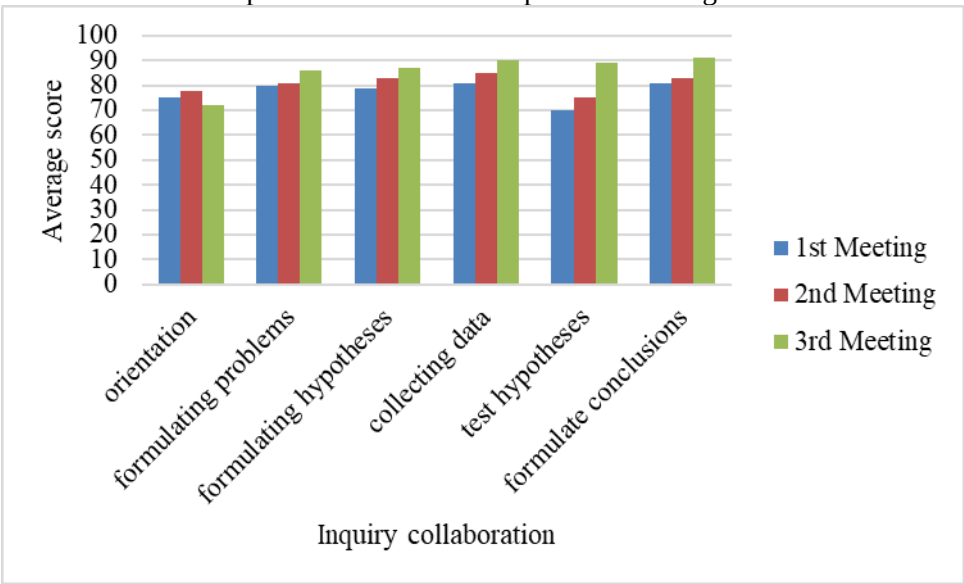

Figure 2. Differences in the average score of student activities per indicator of the inquiry collaborative constructivism model

Based on Figure 2, it can be seen that there are differences in the value of student activities at each meeting for each inquiry indicator. The first meeting of the inquiry model indicator, which showed the highest average value, was the indicator of collecting data and formulating conclusions with the value of 81, while the inquiry indicator, which showed the lowest value, was testing the hypothesis with the value of 70. The second meeting of the indicators, which had the highest average value, was at the indicator formulates a conclusion with the value of 80. In contrast, the indicator that had the lowest value was the indicator that tests the hypothesis with the value of 75. The third meeting of the indicators of the guided inquiry model with the highest average value was the indicator that collects data with the value of 91, while the indicator that had the lowest average value, i.e., on the orientation indicator with the value of 82.

The indicators with the highest average value at each meeting are not always the same as well as the indicators with the lowest score at each session are also not always the same. It is stated that each indicator in guided inquiry has the same opportunity to become an indicator that makes students active in learning activities. Student activity increases during the application of constructivism learning in collaboration with inquiry. Student activity increased, as seen from each meeting, and the indicators of inquiry that were applied increased. Sugrah (2020) explained that the growth of competencies in learning will be created if students act as active agents in the process of imparting knowledge. This is related to the constructivist learning theory, which defines teachers not only able to transmit knowledge to students but students who need to be taught. Actively build knowledge in students' minds. Constructivism learning theory creates freedom for humans who want to learn or seek their needs with the ability to find their wants or needs through roles or facilities from other people.

Moreno (2010) explains in Setiawan et al. (2019:8) that the constructivism learning model can actively connect students with the experience to develop a meaningful understanding. Mason & Singh (2011) explain in Setiawan et al. (2019:8) that students in constructivist learning try to understand new knowledge with existing knowledge. In this case, students with high-problem solving ability tend to use qualitative arguments based on the science concept that underlie the problem, evaluate solutions, and use representational aids. Meanwhile, students with low-problem solving ability tend to recognize problem based on the presentation of the problem and do not evaluate. Therefore, inquiry emphasizes the activities

of students who are required to find solutions to their own problem. This certainly can be accomplished if students can think critically.

The indicators of students' critical thinking skills used in the pre-test and post-test questions are 1) analyzing, 2) synthesizing, 3) evaluating, 4) generalizing. These indicators are adopted from the critical thinking model (Nafiah, 2014). Ratnasati & Nurhidayah (2020) explained that critical thinking skills require students to reason. The difference in the average of pre-test and post-test values for each indicator can be seen in Figure 3.

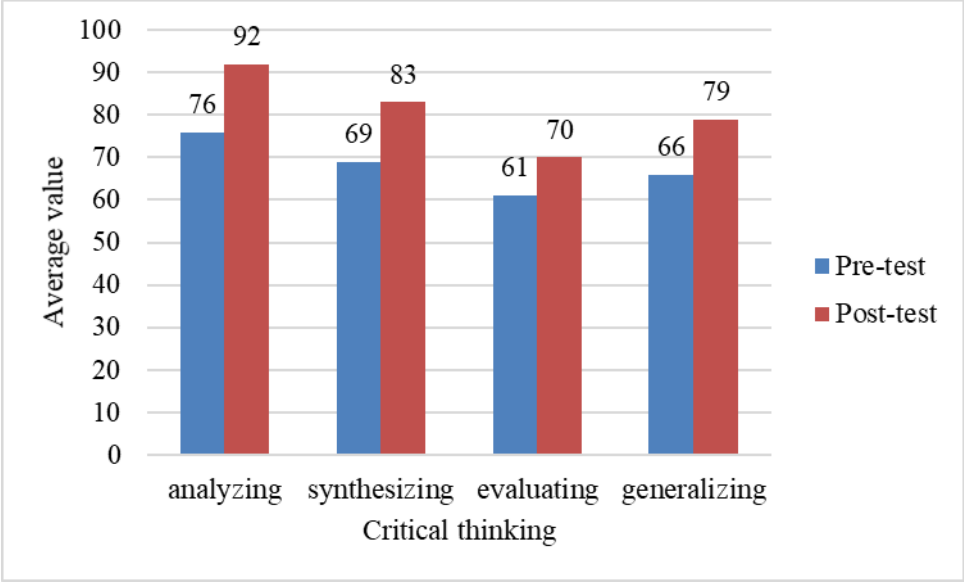

Figure 3. The average value of pre-test and post-test indicators of students' critical thinking skills

Based on Figure 3, the average value of each indicator of critical thinking skills on student learning outcomes has increased for the post-test results when compared to the pre-test results. Critical thinking skills developed in this study are mental processes for analyzing or evaluating information. The information is obtained from observations, experiences, and the communication process. Budiarti et al. (2016) stated that the benefits of training and repetition can develop thinking skills. Students are directed to be able to think coherently, increase knowledge and apply knowledge so that they can achieve effectiveness in learning.

The indicator of critical thinking skills with the highest average value on the pre-test and post-test results is the analyzing indicator. In contrast, the indicator with the lowest average value on the pre-test and post-test results is the evaluating indicator. This is in accordance with the magnitude of the increase in the value of the two indicators. The average value of the post-test indicator analysis also has the most significant difference from the average value of the pre-test of 16 scores, and the average value of the post-test indicator evaluation with the slightest difference from the average value of the pre-test, namely 9 scores.

The statistical tests of learning outcomes were carried out to determine an increase in students' critical thinking skills in students' pre-test and post-test scores. Before statistical tests are carried out, the data obtained must be tested for normality and homogeneity first. This study uses only one sample which is used as a class that is treated in the form of learning using the inquiry-collaborating constructivism model. Therefore, the data obtained is confirmed to be homogeneous because it is obtained from only one sample. The data are normally distributed and homogeneous, so the hypothesis is tested using a parametric test (Paired-Sample t-test) because this study only uses one sample. The results of hypothesis testing on the pre-test and post-test values are exhibited in Table 2.

Table 2. Hypothesis test results pre-test and post-test scores in general

Data	Hypothesis testing	Mean	Sig. 2-tailed	Description
Pre-test-Pos-test	Paired-Sample t test	-12.742	0.000	Significantly different

Based on table 2, it can be seen that the 2-tailed significance was < 0.05. This indicates that H0 is rejected, meaning that there is a significant difference between the pre-test and post-test scores. The mean result is negative indicating that there is a significant difference between the pre-test and post-test scores after the application of the inquiry-collaborating constructivism learning model. The average increase was 12.74286. This is in accordance with the application of learning carried out by Fithriani et al. (2016). Learning by applying the inquiry model can involve students in critical thinking activities using the basic thought process to analyze an opinion and bring up knowledge openness to every meaning and interpretation to develop cohesive and logical reasoning. Critical thinking skills can be improved through research, context, reasoning, and reflection activities (Malik et al., 2019)

Table 3. Hypothesis Test Results Pre-test and Post-test Values for Each Indicator

Data	Hypothesis testing	Mean	Sig. 2-tailed	Description
Indicator 1	Wilcoxon	-4.794	0.000	Significantly different
Indicator 2	*Paired-Sample t test*	-13.914	0.000	Significantly different
Indicator 3	Wilcoxon	-2.503	0.012	Significantly different
Indicator 4	Wilcoxon	-3.144	0.002	Significantly different

Based on Table 3, the 2-tailed significance for each indicator was <0.05. This indicates that H0 is rejected, meaning that there is a significant difference between the pre-test and post-test scores for each indicator. The results in indicator 1 (analyzing), the mean is negative, indicating a significant difference between the pre-test and post-test scores in indicator 1 (analyzing) with an average increase of 4.794. The results on indicator 2 (synthesize), the mean is negative, indicating a significant difference between the pre-test and post-test scores in indicator 2 with an average increase of 13.914. The results on indicator 3 (evaluating), the mean is negative, showing a significant difference between the pre-test and post-test scores on indicator 3 with an average increase of 2.503. The results on indicator 4 (generalizing), the mean is negative, showing a significant difference between the pre-test and post-test scores on indicator 4 with an average increase of 3.144.

Learning in constructivism classes, students are directed to student-based knowledge to encourage the development of natural curiosity in students (Yuliani et al., 2021). Based on these results associated with research conducted by Maryam et al. (2020) revealed that through constructivism learning in collaboration with inquiry, students can be more active in learning. Inquiry trains students in intellectual skills, critical thinking, and problem-solving abilities. In this context, students are expected to be able to relate it in everyday life so that students are proficient in dealing with problems or phenomena in real life that require students to think. Students can form knowledge through interactions that occur during collaborative practicum activities (Malik, & Ubaidillah, 2021). Critical thinking skills can be developed through investigation activities in science laboratories (Malik, & Ubaidillah, 2020). Jayadinata and Gusrayani (2016) explain that the learning process using the inquiry method can develop students' critical thinking skills. This is because necessary thinking skills need reasons that can strengthen the acceptance of something. Hunaepi et al. (2020) argue that critical thinking is essential to be trained in the learning process so that students have the provision of critical, innovative, and creative thinking.

4. CONCLUSION

Based on the problems discussed, it can be concluded that the application of the inquiry-collaborating constructivism model in biology learning was very effectively used to improve students' critical thinking skills. It can be seen during the observation of learning in the classroom that students become more active. The results of the average value of the student activity showed results with very good criteria for each meeting. Based on the hypothesis test, it is known that the 2-tailed significance was < 0.05, indicating that there was a significant difference between the pre-test and post-test scores after the application of the inquiry-collaborating constructivism learning model. The application of learning with various models that require students to be more active in learning is expected to continue to be carried out and developed so that students can later have an influence on improving the quality of human resources in Indonesia.

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