Analysis of critical thinking skills in microbiology learning through mini project assignments during the Covid-19 pandemic

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Abstract. Covid-19 pandemic has colored a new order of learning in Higher Education, from conventional learning towards online and offline learning. Learning in Higher Education is expected to improve students' critical thinking skills. Learning microbiology that the material is learned about microorganisms so it needs analysis of thinking skills, so with a contextual-based approach. The assignment of a mini research project as an alternative to improve critical thinking skills. The purpose of this study was to analyze the critical thinking skills of students giving mini research project assignments on microbiology learning during the Covid-19 pandemic. The method in this study was descriptive qualitative. The results showed students' critical thinking skills in the ability to identify and the ability to evaluate very well a number of 11 students (100%) got a score of 4 (the highest score) while the ability to link a number of 9 (81.82%). Conclusions in the research assignment of mini research projects could improve critical thinking in the ability to identify and evaluate problems in the category is very good.

1. Introduction
Covid-19 pandemic that has occurred in Indonesia and even in the world has an impact on the learning process both elementary, secondary and tertiary level. This change in learning colors a new order that demands creativity and innovation power for teachers and lecturers, so that learning continues and does not cause boredom for learners, especially students who in addition to mastering cognitive skills must also develop critical thinking. Critical thinking is an activity of thinking about ideas related to a problem or concept described [1][2][3]. This critical thinking ability can be trained and developed through practice in problem solving through assignments that require students to solve systematically with the scientific method. During the Covid-19 pandemic there were changes in the learning process at both the elementary and tertiary levels so that from conventional learning switched to online learning. Online learning that is given must still improve critical thinking skills, especially for learning at the College level. Microbiology learning in higher education demands an increase in critical thinking skills for students because this course studies microscopic and macroscopic material so that in learning in the pandemic era Covid-19, learning methods that can improve critical thinking skills should be chosen. The assignment of mini project assignments in microbiology learning can be used as an alternative to improve critical thinking skills because the mini project assignments can train students to think logically and systematically based on scientific principles. This is in accordance with the study of Enzai, et al [4], which revealed that mini project assignments can improve critical thinking skills in learning in higher
education. This study aims to analyze critical thinking skills through assigning in mini research projects to microbiology learning during the Covid-19 pandemic.

2. Methods

This research is a qualitative descriptive study carried out for eight times face to face, from March to May 2020, which is carried out by providing microbiology material online and then assigning mini research project assignments by making hand sanitizer as the task of sterilization material. The research subjects were biology education students in semester VI of Unirow Tuban T.A 2019/2020 who took 11 microbiology courses. Research data were analyzed descriptively qualitatively [5]. The initial step in this research is to make instruments for critical thinking skills, then make a questionnaire through the Google form in accordance with indicators of critical thinking skills and then the results of the questionnaire are analyzed to determine students' critical thinking skills during microbiology courses through assignment of mini research projects. Indicators for assessing critical thinking skills include: the ability to identify, ability to cause problems, the ability to analyze, evaluation ability, and linking ability.

During lectures lecturers provide material online until eight (8) face-to-face then in the subject matter sterilization give mini research project assignments to students independently because during the Covid-19 pandemic the assignment is carried out independently. The results of student assignments are collected in the form of videos for assessment, then a questionnaire to determine students' thinking abilities is given in the form of Google form then an analysis of critical thinking skills with criteria score 1-4, score 1 category is less, score 2 categories is enough, score 3 category is good and score 4 is very good.

3. Result and Discussion

Research has been conducted on biology education students at the PGRI Ronggolawe University semester VI T.A 2019/2020 who have taken microbiology courses in the subject matter of structuring. Research data are presented in pictures and tabulated data.

![Figure 1. Example of a hand sanitizer resulting from a minimum research project task.](image)

**Table 1. Biology Student Learning Outcomes on Sterilization Material Assigned by a Mini Research Project**

| No. | Sex   | Total | Score ≤ 60 | Score ≥ 60 |
|-----|-------|-------|------------|------------|
| 1.  | Male  | 1     | 0          | 1          |
| 2.  | Female| 10    | 1          | 9          |
|     | Total | 11    | 1          | 10         |
Table 2. Results of the Questionnaire on the Critical Thinking Ability of Biology Students by Giving Mini Research Project Assignments to the Structuring Material

| No. | Questionnaire Item                                                                 | Score | Total |
|-----|-----------------------------------------------------------------------------------|-------|-------|
| 1.  | Do you understand the task of a mini research project on sterilization material?  |       | 3     |
|     | a. Very understanding                                                             | ✓     | 7     |
|     | b. Understanding                                                                  | ✓     | 1     |
|     | c. Quite understand                                                               |       | 0     |
|     | d. No Understand                                                                  |       | 0     |
| 2.  | Are you able to complete the task?                                                | ✓     | 2     |
|     | a. Able                                                                           | ✓     | 8     |
|     | b. Quite able                                                                     | ✓     | 1     |
|     | c. No capable                                                                     |       | 0     |
| 3.  | Are you having problems doing the task?                                          | ✓     | 5     |
|     | a. Yes                                                                            |       | 3     |
|     | b. No                                                                             |       | 0     |
|     | c. Maybe                                                                          | ✓     | 3     |
|     | d. The other                                                                       |       | 0     |
| 4.  | If you encounter problems, can you consult with the lecturer supporting the course?| ✓     | 11    |
|     | a. Yes                                                                            |       | 0     |
|     | b. No                                                                             |       | 0     |
|     | c. Maybe                                                                          |       | 0     |
|     | d. The other                                                                       |       | 0     |
| 5.  | Does the lecturer supporting the course help you to find a solution?              | ✓     | 11    |
|     | a. Yes                                                                            |       | 0     |
|     | b. No                                                                             |       | 0     |
|     | c. Maybe                                                                          |       | 0     |
|     | d. The other                                                                       |       | 0     |
| 6.  | Can you identify the problem that you are encountering?                           | ✓     | 11    |
|     | a. Yes                                                                            |       | 0     |
|     | b. No                                                                             |       | 0     |
|     | c. Maybe                                                                          |       | 0     |
|     | d. The other                                                                       |       | 0     |
| 7.  | Can you evaluate your task in accordance with the sterilization material?         | ✓     | 11    |
|     | a. Could                                                                          |       | 0     |
|     | b. Could not                                                                      |       | 0     |
|     | c. Maybe                                                                          |       | 0     |
|     | d. The other                                                                       |       | 0     |
| 8.  | Can you link this material with other microbiological material?                   | ✓     | 9     |
|     | a. Can                                                                            |       | 2     |
|     | b. Can not                                                                        |       | 0     |
|     | c. Maybe                                                                          | ✓     | 0     |
|     | d. The other                                                                       |       | 0     |
| 9.  | Does this task increase your ability to conduct research?                          | ✓     | 10    |
|     | a. Yes                                                                            |       | 1     |
|     | b. No                                                                             |       | 0     |
|     | c. Maybe                                                                          | ✓     | 0     |
|     | d. The other                                                                       |       | 0     |
| 10. | Are mini research project assignments suitable for learning during the Covid-19 pandemic? | ✓     | 11    |
|     | a. Yes                                                                            |       | 0     |
|     | b. No                                                                             |       | 0     |
|     | c. Maybe                                                                          | ✓     | 0     |
|     | d. The other                                                                       |       | 0     |
|     | Total                                                                             |       | 11    |
The results of the assessment of student assignments on student sterilization material that scored less than 60 were 1 (9.0%) consisting of 0 men and 1 woman while those who scored more than 60 were 10 (90.1%) consisting of 1 male and 9 females. Most student learning outcomes (90.9%) scored more than 60 in table 1 with microbiology learning through the assignment of a mini research project on sterilization material. This assignment was given after the sterilization material was explained, the task given to make hand sanitizers made from natural materials could be done very well.

The results of the questionnaire in table 2 are based on indicators of critical thinking, namely the ability to identify, the ability to solve problems, the ability to analyze, the ability to evaluate and the ability to link. Critical thinking skills of students in the ability to identify and the ability to evaluate very well a number of 11 students (100%) get a score of 4 (highest score) while the ability to link a number of 9 (81.82%), the ability to solve problems a number of 5 students (45.45%) get score 4 (highest score). The results of this study indicate the mini assignment of a research project to make hand sanitizers on sterilization material is very good in improving students' critical thinking skills in the ability to identify and evaluate because all students get the highest score. The results of this study are in line with research by Wijayanti, 2014 [6] and Lubis et al, 2020 [7] that the assignment of a mini research project can improve students' critical thinking skills, because the assignment of this mini research project can, among other things, train students' ability to solve problems, analyze problems. According to Arends (2012) [8] critical thinking is a type of thinking that involves the use of analytical and evaluative cognitive processes, especially analysis related to arguments based on logical consistency that aims to recognize bias and errors in reasoning. Christian thinking is also related to the character values that must be possessed by students[9][10].

The assignment of a mini project during the Covid-19 pandemic also had an impact on student creativity and innovation because students were given the freedom to work on assignments in accordance with the wishes and abilities of students so that students were also free to develop their thinking abilities, this was what spurred students' critical thinking skills. Project-based learning can facilitate student learning actively so that students' critical thinking skills increase [11]. The development of critical thinking skills and creative thinking can be assisted through the application of appropriate and meaningful learning[12][13]. Contextual-based microbiology learning can improve higher-order thinking skills and learning from local materials can also improve responses and thinking skills critical[14][15][16] this is in line with the results of research by researchers that learning microbiology by assigning mini research projects can improve critical thinking skills, especially in identifying, evaluating and linking problems.

4. Conclusion

Based on the analytical results of the research and discussion, the ability to think critically through assigning mini research projects on microbiology learning during the Covid-19 pandemic the most dominant is the ability to think critically in identifying and evaluating in categories very well and the ability to link in categories both.

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