How is the mathematical critical thinking disposition of vocational school students in online learning during the COVID-19 pandemic?

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Abstract. This study aims to determine the mathematical critical thinking disposition of vocational school students in mathematics learning during the COVID-19 pandemic in terms of six indicators, i.e., 1) truth-seeking, 2) open-mindedness, 3) analyticity, 4) systematicity, 5) self-confidence, 6) curiosity. The research methodology used is a qualitative methodology with a case study research design. The research sample was vocational students in Cirebon and Indramayu who were carrying out online learning. The research data were taken by providing a mathematical critical thinking disposition questionnaire distributed online via Google Form. This study shows that the mathematical critical thinking disposition of vocational school students during the COVID-19 pandemic on the truth-seeking indicator got a percentage of 57.60% in the excellent category, the open-minded indicator got a percentage of 76.04% in the excellent category, the systematic indicator got a percentage of 72.79 % in the excellent category, the analytical indicator got a percentage of 66.23% in enough category, the confidence indicator got a percentage of 62.07% in enough category, and the curiosity indicator got a percentage of 68.49% in enough category. The achievement of all indicators got a percentage of 67.19% and is in the good category. This means that students have good attitudes or tendencies to think rationally and reflectively to make decisions under certain conditions.

1. Introduction

World conditions affected by COVID-19 force us to do learning at home by holding online or virtual classes. Online learning uses internet networks with accessibility, connectivity, flexibility, and the ability to generate various types of learning interactions [1]. Many aspects can be taken into consideration for implementing online learning. These aspects start from the student's interest in learning, the effectiveness of students in understanding the subject matter, and the adaptation of students in using new learning media. However, online learning also creates difficulties in terms of internet connection. A number of studies conducted on the effectiveness of learning during the pandemic have concluded that online learning needs to be specially designed and carefully prepared, so that students can immediately adapt to changes that occur during the pandemic [2-5]. Furthermore, students better understand the teacher's explanation directly, students have difficulty understanding the
material being taught, students feel stressed by online assignments, and students are dizzy and tired of being in front of a laptop or android continuously [6]. During the lockdown period, around 70% of learners were involved in e-learning. Most of the learners were used android mobile for attending e-learning.

Moreover, students face various problems related to depression, anxiety, poor internet connectivity, and an unfavorable study environment at home [7]. The results showed that many students had difficulties understanding the course material provided online. Lecture materials, mostly reading materials, cannot be comprehensively understood by students [6]. This deficiency is expected to allow students to receive a form of learning that can train students to think critically and responsibly in facing challenges ahead.

Critical thinking is: (1) a set of cognitive skills, such as identifying central issues and assumptions, evaluating evidence, and deducing conclusions; and (2) a disposition based on the willingness to apply critical thinking skills [8,9]. The disposition of critical thinking is one of the factors supporting students' critical thinking skills. A person who has a critical thinking disposition will tend to think critically when they meet a situation that triggers critical thinking [10-12]. Critical thinking disposition is a trait inherent in a person who thinks critically. For example, a person who has a critical thinking disposition will have a positive attitude when facing mathematics problems. This tendency dramatically affects students' critical thinking skills. Based on the above, it can be concluded that critical thinking disposition is the tendency of students to think using analytical and reflective thinking skills to make decisions in certain conditions.

This study aims to provide an overview of students' mathematical critical thinking disposition during the COVID-19 pandemic in its natural context without any intervention from outside parties. The indicators used to measure students' mathematical critical thinking dispositions are six of the seven indicators, i.e., 1) truth-seeking, 2) open-mindedness, 3) analytical, 4) systematicity, 5) self-confidence, and 6) curiosity [10]. The selection of indicators is based on consideration of their suitability with the characteristics of learning carried out during the COVID-19 pandemic. This study focuses more on students' critical thinking disposition in facing challenges where students get more pressure from learning situations and conditions during the COVID-19 pandemic.

2. Methods

This study uses a qualitative methodology because it requires open observation and closeness between the researchers and the informant. The data obtained is more in-depth and accurate. The researchers use a case study research design because it can examine an issue in-depth and broadly. Researchers can analyze in depth any situations or cases that occurred during online learning in the COVID-19 pandemic.

The sample used in this study were vocational high school students in Cirebon and Indramayu who were carrying out online learning. Vocational high school (SMK) students must immediately go to the career world from attitudes and tendencies to think critically. They quickly adapt to certain situations or circumstances. One of the reasons for choosing SMK students is that SMK students are prepared to become graduate students who have skills in their fields, adapt, and compete in the career world.

Data were collected by distributing an online mathematical critical thinking disposition questionnaire using Google form. The questionnaire was prepared according to critical thinking disposition indicators, i.e., truth-seeking, open-mindedness, analytical, systematic, self-confidence, and curiosity. The questionnaire used was construct validated by consulting the experts (judgment expert) in education. There are four answer choices in the mathematical critical thinking disposition questionnaire, i.e., Strongly Agree, Agree, Disagree, and Strongly Disagree. The assessment criteria used are shown in Table 1.
Table 1. Criteria of Alternative Answer Scoring

| Alternative Answers | Type of Statement |
|---------------------|-------------------|
| Strongly Agree      | +                 |
| Agree (S)           | +                 |
| Disagree            | -                 |
| Strongly Disagree   | -                 |

Table 2. Category of Mathematical Critical Thinking Disposition Percentage

| No. | Interval                                      | Category  |
|-----|-----------------------------------------------|-----------|
| 1   | 90 < percentage of disposition ≤ 100         | Very Good |
| 2   | 70 < percentage of disposition ≤ 89          | Good      |
| 3   | 50 < percentage of disposition ≤ 69          | Enough    |
| 4   | 30 < percentage of disposition ≤ 49          | Not good  |
| 5   | 10 < percentage of disposition ≤ 29          | Poor      |

3. Results and Discussion

The results of the study showed that students use a lot of media in the online learning process. The media used are Google Classroom, WhatsApp, Edmodo, Moodle, and others. The results on the level of critical thinking disposition that follow online learning need to be described as a whole and for each indicator. The following are the results of mathematical critical thinking disposition research.

Table 3. Category of Mathematical Critical Thinking Disposition of Vocational School Students

| Indicator of Mathematical Critical Thinking Disposition | Percentage (%) | Category  |
|--------------------------------------------------------|---------------|-----------|
| truth-seeking                                          | 57.60         | Enough    |
| open-mindedness                                        | 76.65         | Good      |
| Systematicity                                          | 72.79         | Good      |
| Analytical                                             | 66.23         | Enough    |
| self-confidence                                        | 62.07         | Enough    |
| Inquisitiveness                                        | 68.49         | Enough    |
| Overall                                                | 67.30         | Enough    |

Based on Table 3, the percentage of students' critical thinking dispositions was 67.30% in the excellent category. This means that students have sufficient critical thinking disposition skills during online learning during the COVID-19 pandemic. The following research results are reviewed from each indicator of mathematical critical thinking disposition. The percentage of students' truth-seeking is 57.60% in the excellent category. This shows that students are always deep enough to make an effort to get correct information and make an effort to find other alternatives. Online learning should make students have many attitudes, such as always trying to get the correct information and finding other alternatives. This statement is in line with the opinion that online distance learning can foster student learning independence [13]. Learning without direct guidance from the teacher makes students independently seek information about the material and assignments. Some of the activities carried out are reading reference books, online articles, scientific journals, or discussing with peers through instant messaging applications. Students' level of open-mindedness during online learning during the COVID-19 pandemic got a percentage of 76.65% and was included in the excellent category. It can be said that students are sensitive to their feelings that they believe there are other ways to solve math problems other than those taught by the teacher in online learning. It is not impossible that students will be open to all possible answers and do not control their minds based solely on the knowledge or experience they have gained themselves. Relevant research results show that students' open-
mindedness is seen when making presentations. Students discuss the percentage results with other groups to get reliable information and when students do not understand the material being taught [13].

The level of systematic indicators of students with sub-indicators of orderly work and being diligent in looking for relevant information or reasons during online learning in the COVID-19 pandemic got 76.65% and was included in the excellent category. Students who are always looking for relevant information or reasons when completing assignments during learning can be categorized as students who can think systematically. These students can work orderly. This means that when a student faces a problem in a structured manner, the student solves the problem according to the sequence, stages, and system. Then, it can be said that the student has done their thinking systematically. The students' analytical indicators in online learning during the COVID-19 pandemic got a percentage of 66.23% and were included in the excellent category. Thus, students are sufficiently focused on the main problems they encounter when taking online learning during the COVID-19 pandemic.

Students who focus on the central problem will begin to sort and identify the essential and relevant parts of a problem, determine the solution strategy, and be diligent in seeking an explanation of a conclusion. In learning mathematics, students are accustomed to thinking analytically (perform analytical thinking). This is especially necessary for solving a problem since thinking analytically in making decisions and being diligent in reasoning is highly required. During online learning, student confidence indicators during the COVID-19 pandemic got 62.07% and were included in the excellent category. The sufficient point here is that students have the confidence in making the inquiry process that is believed to be correct and confident in the reasoning of others who are believed to be correct. However, there is a need for efforts to increase self-confidence to improve student learning outcomes. The high online learning outcomes are influenced by high student confidence.

In contrast, online learning outcomes are low because it is influenced by the low self-confidence of students in the teaching and learning process during the COVID-19 pandemic. The results show that student learning outcomes are low because there is no self-confidence to accept learning challenges. This is in line with relevant findings such as students do not want to issue opinions because they do not believe in their abilities, like to reflect in-class hours, there is no real hope of oneself, so they are not able to realize their hopes [11][14][15]. The results showed that students' curiosity during online learning during the COVID-19 pandemic got a percentage of 68.49% and was included in the excellent category. This means that students can try to use the results of other people's thinking or learn additional math material from other sources to support themselves when online learning takes place. The curiosity achieved in this study indicates the need for improvement efforts to encourage students to be more critical and create motivation to find, know, and learn the material. One indicator of students having a high curiosity is that they can brave enough to ask the teacher during an online discussion about any material they have not mastered.

Based on the findings and research results described above, it can be said that online learning can develop students' critical thinking dispositions. Because each component's critical thinking disposition cannot be said to be good or very good, it is necessary to have a better learning design, assignment, or online teaching material. This is a big task not only for teachers but also for students and even parents. The three essential components (student-teacher-parents) must work together to achieve an excellent critical thinking disposition.

4. Conclusion

The mathematical critical thinking disposition of vocational high school students during the COVID-19 pandemic on the truth-seeking indicator got a percentage of 57.60%, open-minded indicators got a percentage of 76.04%, systematicity indicators got a percentage of 72.79%, analytical indicators got a percentage of 66.23%, self-confidence indicators got a percentage of 62.07%, and the inquisitiveness indicator got a percentage of 68.49%. The achievement of all indicators got a percentage of 67.19% and is in a suitable category. This means that students have good attitudes or tendencies to think rationally and reflectively, so they can make decisions under certain conditions. The ability of
vocational students' mathematical critical thinking disposition during the COVID-19 pandemic has been optimal, but there needs to be an increase in supporting online learning that these students undertake.

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