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Online Learning During The COVID-19 Pandemic: Development of Digital Module to Improve Analytical Skill

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Abstract

The Covid-19 pandemic has caused learning activities that were originally carried out face-to-face in schools to be shifted to online learning. The implementation of online learning has several challenges, one of which is the development of student skills in the 21st century, especially analytical skills. Students' analytical skills are needed in learning physics. Students' analytical skills are currently still in the low category. To support the improvement of students' analytical skills, teaching material in the form of a digital module is applied. The purpose of this study was to examine the role of digital modules to improve students' analytical skills during the Covid-19 pandemic online learning period. The research was carried out using a qualitative descriptive method with 23 students as the subject of a high school in Karanganyar Regency, Indonesia. The study used a quantitative descriptive method with a test technique using 10 essay questions based on three indicators of analytical ability. Data were analyzed using N-gain and paired t-test. The results showed that the average value of analytical ability before using the digital module was 57.84, while the average value after using the digital module was 72.81. Based on the value of N gain, the increase in students' analytical skills on three indicators is included in the moderate category, namely > 0.3. The digital module has a significant effect on improving student analysis.

Keywords: Student Ability in 21st century, Physics Learning, Online Learning.

Introduction

Coronavirus 19 (COVID 19) is an infectious disease caused by respiratory syndrome coronavirus 2 (SARS-CoV-2) (Mehta et al., 2020) and is a group of viruses that can cause disease in birds and mammals, including humans. In humans, coronaviruses cause respiratory tract infections (Pooladanda et al., 2020). The World Health Organization (WHO) declared COVID 19 a health emergency of concern to the international community. The disease has become an ongoing global epidemic in more than 200 countries in the world (Wu et al., 2020). The coronavirus pandemic was reported to have spread to Indonesia on March 2, 2020 (Wahidah et al., 2020). In Indonesia as of March 31, 2020, there were 1,528 confirmed cases of COVID-19 and 136 cases of death related to this disease with the fatality rate (CFR) also much higher than the People's Republic of China (8.9% vs 4%) (Setiati & Azwar, 2020). As a step to prevent the spread of the COVID-19 virus, a system of social and physical distancing was implemented until the implementation of PSBB (Large-Scale Social Restrictions) in several regions in Indonesia (Wardhani, 2021). This affects the education system, namely learning activities must be carried out from home by diverting conventional (face-to-face) learning that is usually done in schools into online learning that can be done at home (Ana, 2020). Online learning is a solution to continuing learning during the COVID-19 pandemic (Tang et al., 2021).

Online learning carried out during the COVID-19 pandemic has several challenges, one of which is the development of student skills in the 21st century (Latorre-Cosculluela et al., 2021). One of the 21st century student skills needed today is higher-order thinking skills. Higher-order thinking is a student's ability to reason, reflect, and make the right decision from a problem. Students who have higher-order thinking skills can apply and relate a learning concept to phenomena in real life (Brookhart, 2010). One aspect of higher-order thinking skills is analytical skills. Analytical skills are needed in learning, especially in learning physics. In physics learning, students not only memorize physics formulas and theories but students are also faced with physics problems that require analysis (Hannum et al., 2019). However, the analytical ability of students in Indonesia is still relatively low. This is evidenced by the low TIMSS results obtained from 1999 to 2015. The low TIMSS results are caused by students in Indonesia not being accustomed to solving problems using higher-order thinking aspects such as analyzing, evaluating, and creating (Mullis, I.V.S., Martin, M.O., Foy, P., & Arora, 2012) (Prawita et al., 2019). Based on the results of the analytical ability test in one of the high schools in Karanganyar, it shows that the students' analytical skills are still relatively low. This is evidenced by the average results of the pre-test of analytical skills, namely the highest score only reaches a value of 6. The average of the three indicators of analytical ability is still low, namely 6.8, 5.9, and 4.9. This low student analytical ability causes student learning outcomes to also below (Çiğrik & Ergül, 2010).

Efforts to improve students' analytical skills have so far been carried out by applying a student-centered learning model (Sudibyo et al., 2016) (Chonkaew et al., 2016) (Sari et al., 2019) as well as the application of modules as supporting teaching materials to improve students' abilities. analysis of students in learning (Prawita et al., 2019) (Sundari et al., 2020) (Karenina et al., 2020). In this study, digital modules are used as a support in learning physics to improve students' analytical skills. The digital module was chosen as supporting teaching material in physics learning because it is a technology-based learning media that is active and interactive. Students can easily access learning anytime and anywhere through electronic devices (smartphones, tablets, and computers) so that students can gain learning experiences both inside and outside the classroom. (Sugiani et al., 2019) (Saputra & Kuswanto, 2019).

Several studies have been carried out, namely Prawita et al (2019) which apply to learn modules to improve students' analytical skills. The module used is still a printed module that is equipped with various learning activities such as exploration and observation which is equipped with image visualization, student worksheets, and concept application activities. However, the use of the print module still has several shortcomings, namely, it can only display learning activities in text form and is equipped with image visualization. Students assess the print module as less interactive so they quickly feel bored in the learning process (Puspitasari, 2019). The module in this study is presented in the form of an android application to make it easier for students to access online physics learning. The digital module is equipped with animated physics and a virtual laboratory that can help improve students' analytical skills. The novelty of this research is presenting the module digitally in the form of an android application and adding video visualizations and physics animations as well as adding virtual laboratory activities. The addition of this content is done so that students can better understand the concept of physics so that students' analytical skills increase. The purpose of this study is to examine the role of digital modules to improve students' analytical skills during the online learning period of the Covid-19 pandemic.

Materials and Methods

Methods

The type of research used is quantitative with a descriptive method. This research was conducted in the 2020/2021 academic year in one of the high schools in the Karanganyar Regency. The research subjects were 32 students of class X SMA. The analytical skill test was measured by 10 essay questions based on

three indicators of analytical ability according to Anderson & Krathwohl. namely Differentiating, Organizing, and Attributing. The three indicators are related to each other in the question.

Data Analysis

Data were analyzed using N-gain and paired t-test. Normalized N-gain <g> is used to determine the effectiveness of the application of digital modules in improving students' analytical skills. Improving students' analytical skills is done by comparing the results of the average pre-test and post-test analytical skills. A cognitive ability pre-test was conducted before applying the digital module in physics learning. The post-test of cognitive abilities was carried out after applying the digital module in physics learning. The normalized N-gain score formula is shown in the equation below:

$$\langle g \rangle = \frac{(S_{post} - S_{pre})}{(S_{\max} - S_{pre})}$$

Table 1. Interpretation of Mean of N-gain Value

Value <g>	Classification
$\langle \boldsymbol{g} \rangle \geq 0{,}7$	High
$0{,}7 < \langle \boldsymbol{g} \rangle \leq \mathbf{0,3}$	Medium
$\langle \boldsymbol{g} \rangle < \mathbf{0,3}$	Low

(Hake, 1999)

Paired T-test was used to determine the significance of the application of digital modules in improving students' analytical skills. This analysis uses the SPSS 18 program. Several conditions must be met before performing a paired t-test; that is, the data must be normalized and homogeneous. Therefore, the normality test was carried out using the Shapiro-Wilk test, and the homogeneity test using the Levene test (Sudibyo et al., 2016). Drawing conclusions using paired t-test, with the following conditions:

1) Ha: There is a significant average difference between analytical skills before and after using the digital module modules
2) H0: There is no significant average difference between analytical skills before and after the use of digital modules

Results and Discussion

Significance of Analytical Skills Improvement

The results of the descriptive analysis of the scores of each student's analytical ability are shown in Table 2. The average value of the pre-test of students' analytical skills is 57.84. After applying the digital module in physics learning, the average post-test of students' analytical skills became 72.81. The results showed that the post-test average of students' analytical skills was high compared to the pre-test average.

Table 2. Student Analysis Ability Score

Test	Mean	Max.	Min.
Pre-test	57.84	80	35
Post-test	72.81	92	50

Table 3. Normality Test Result

		Shapiro-Wilk	
Test	**Statistic**	**Df**	**Sig.**
Pre-test	.962	32	.316
Post-test	.936	32	.056

Table 4. Homogeneity Test Result

	Levene Statistic	df1	df2	Sig.
Based on Mean	.039	1	62	.844

Based on the data in Table 3, the significance value of the Shapiro-Wilk normality test is (p>0.05) so that the students' analytical ability data is said to be normally distributed. Homogeneity Test Table 4 shows the results of the significance value (p> 0.05) so that the data on the student's analytical ability is homogeneous. After the prerequisite tests are met, then a paired t-test is carried out using SPSS 18. The results of the paired T-test are shown in Table 5.

Table 5. Paired Samples T-Test

	Mean	df	Sig. 2-tailed
Pre-test - Post-test	-14.969	31	.000

Paired t-test results show that the application of digital modules in learning has a significant effect on improving students' analytical skills. This is evidenced by the significance value of the analytical ability of 0.000 (Table 5). This significance is smaller than 0.05 (p <0.05) so that the research hypothesis is accepted, namely that there is a significant difference between students' analytical skills before and after using digital modules in physics learning. The results showed that the post-test scores for analytical skills were higher than the post-test scores (Table 2). The difference in the value of post-test and pre-test in analytical skills is significantly influenced by the application of digital modules in physics learning.

The use of digital modules has proven to be effective in improving students' analytical skills in online physics learning. This is evidenced by the increase in the average post-test of students' analytical skills which is higher than the results of the pre-test (Table 2). This condition is in line with the results of research by (Karenina et al., 2020) & (Prawita et al., 2019) that students who learn to use an integrated module in the aspect of analytical skills have higher analytical skills than students who learn to use conventional modules. This is evidenced by the post-test score of students' analytical skills after using the module in learning is higher than the pre-test score before using the module.

The use of digital modules in physics learning is proven to improve students' analytical skills (Table 2). This is because the digital module contains activities that can improve students' analytical skills such as exploring activities, formulating problems, virtual laboratories, and data analyzing activities. This is in line with the research results of (Smith & Blankinship, 2000) & (Amin & Ikhsan, 2021) that the application of virtual laboratories in learning has a significant effect on increasing students' higher-order thinking skills (HOTS). In addition, activities in virtual laboratories help students in developing their thinking skills such as exploring a problem, identifying variables in experiments, and data analysis activities (O'Flaherty & Costabile, 2020). Through this activity, students can develop higher-order thinking skills, especially in the ability to analyze. Thus, the virtual laboratory can be said to be the best multimedia used to improve students' higher-order thinking skills such as in the aspects of analysis, synthesis, and evaluation (Kirschner & Huisman, 1998).

Figure 1. Virtual Laboratory of Newton's Law Digital Module

Analytical Thinking Skills Improvement Categories

The results showed that the average post-test score for each indicator of students' analytical ability was higher than the average pre-test score for each indicator (Table 2). The average pre-test score for each indicator of analytical ability is 6.8 for the first differentiating indicator, 5.9 for the two organizing indicators, and 4.9 for the three attributing indicators. Meanwhile, the average post-test score on each indicator of analytical ability is 8.0 for the first indicator of differentiating, the second indicator of organizing is 7.4 and the third indicator of attributing is 6.7 (Table 6).

Table 6. The Improvement of Student's Analytical Skill

Aspect of Analytical Thinking	Mean Pre-test	Mean Post-test	Mean N-gain	Category
Differentiating	6,8	8,0	0,38	Medium
Organizing	5,9	7,4	0,36	Medium
Attributing	4,9	6,7	0,34	Medium

The improvement of students' analytical skills is evidenced by the average N-gain pre-test and post-test scores on each indicator of students' analytical abilities (Table 3). The results of the average N-Gain value in the first indicator is 0.38, the second indicator is 0.36 and the third indicator is 0.34. The average N-Gain score of students' analytical skills is greater than 0.3 (> 0.3) belonging to the medium category (Hake, 1999). This proves that the process of learning physics using digital modules has a positive effect on improving the analytical skills of class X high school students.

The highest increase in the aspect of analytical ability is in the distinguishing aspect, while the lowest increase is in the attribution aspect (Table 6). Distinguishing is a student's ability to select relevant and irrelevant information (Anderson et al., 2001). The differentiating indicator has the highest increase in aspects compared to other aspects (Table 6). This is because, at the beginning of learning, students are trained to observe physical phenomena which are presented in the form of video or image shows. This phenomenon is often encountered by students in real life so that students can more easily analyze the phenomenon and choose information to formulate problems and propose hypotheses (Juniwati et al., 2020) (Prawita et al., 2019). This is in line with the research results of (Irwanto et al., 2017), (Sundari et al., 2020) & (Putri et al., 2019) that the highest increase in analytical ability is in the distinguishing aspect. In this aspect, students can determine the information that is by the phenomenon so that the activities of formulating problems and proposing hypotheses become easier.

The lowest aspect of improving the analysis ability occurred in the attribution aspect (Table 6). This is because students still feel confused in determining the point of view of a problem. It is proven that when students are given questions to determine the relationship between variables based on a graph, there are still many students who answer wrongly. This condition is in line with the results of research (Sudibyo et al., 2016) (Irwanto et al., 2017) (Sundari et al., 2020) that the attribution aspect is the aspect of analytical ability with the lowest increase. Low attribution ability will cause students to have difficulty in constructing physics concepts. Based on the results of the study, the analytical ability in the attribution aspect after using the module has increased but the increase is still relatively low when compared to other aspects of analytical ability.

Digital modules are used as a source of learning physics during the COVID-19 pandemic which can effectively improve students' analytical skills. Students can access learning through modules repeatedly, anywhere, and anytime without time restrictions. The use of digital modules is expected to provide convenience for students in studying the subject matter, especially physics subjects.

Conclusion

The digital module can effectively improve students' analytical skills in learning physics by increasing the average pre-test and post-test scores. The results revealed that students who used digital modules in online learning during the Covid 19 pandemic had an average score of higher analytical skills than the average pretest score. The N-gain values in each aspect of analytical ability are 0.46, 0.46, and 0.37. This proves that the use of digital modules as supporting teaching materials in physics learning during the Covid-19 pandemic can improve students' analytical skills.

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